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Proper Use of Terms. BESIDES the terms kilowatt-hours and horse-power hours, to the loose use of which we referred some weeks ago, there is another to which attention ought to be called—it is the term "horse-power per year." This evidently means one horse power, but does it mean at the rate of 24 hours or 10 hours per day, or is the labor of a mechanical horse also controlled by the labor unions and limited to eight hours per day? In speaking of the cost of a horse power per year there might be a difference of as much as 100 per cent., depending on what constitutes a working day of a steam engine, electric motor or turbine. Eminent writers frequently use this term in such a loose way as to greatly diminish the value of the interesting data which they give. Why not say: A horse power per year at so-and-so many hours per day?

The Tesla Lecture. THE lecture of Mr. Nikola Tesla before the St. Louis Convention of the National Electric Light Association, which attracted so much attention, and which we promised to publish in full in this issue of THE ELECTRICAL WORLD, will have to be held for another issue in the near future. We regret this delay, but it is unavoidable under the circumstances, for Mr. Tesla preferred that before it was published he should have an opportunity of thoroughly revising it, which, on account of ill health, he has been unable to do up to the present time. We are unwilling to publish this important lecture until we can give it in full, and in such form as will meet Mr. Tesla's approval, and have therefore thought it best to defer action in the matter until the lecture can be given complete. It seems probable that Mr. Tesla's lecture will appear either in the next issue or that immediately following.

Continuous Contact Microphones. IN connection with the expired telephone patent, it may be of interest to call the attention of those who intend to go into the telephone business to the microphone described in our issue of Feb. 4, p. 90, which shows that microphones may be made according to a different principle than that in the long-lived patent issued not long ago. Instead of the "loose contact" on which all former microphones are based, this one is made of a continuous conductor which changes its shape and therefore its resistance. Strange to say, this new microphone, which appears to evade the monopoly patent, makes a far better instrument than the others, if reports from presumably reliable sources may be depended upon. Inventors need therefore not be discouraged by the broad U. S. patent for loose contact microphones; it is not like the telephone patent, which practically covered the electrical transmission of speech, no matter what apparatus was used.

Electric Experiments and Phenomena. EUROPEANS are great experimenters, and in their numerous patient researches they often arrive at very interesting results. The descriptions of such experiments generally find their way into the journals of those countries, and are, therefore, mentioned in our digest each week. Among those described this week we call attention to the curious experiment of Lord Armstrong, in which a cotton thread was drawn out of one glass of water into another by the action of an electric passage from an influence machine or an induction coil. Another is an interesting lecture apparatus, which may readily be used by any one having an incandescent light current at his disposal; we refer to the electric furnace of Mr. Moissan. It is so simple and cheap an apparatus that it might form a very useful addition to the workshop of an experimenter. With this furnace Mr. Moissan found that he could produce artificial diamonds, not of the paste kind, but real diamonds of crystallized carbon, genuine in every way except that they are made in a few minutes in an electric furnace instead of by the action of unaided nature.

A Compact Motor. WE call attention to an illustrated article in another column descriptive of a new motor about to be put on the market, which possesses some novel features in design. It will be observed that although this is a four-pole motor, it has eight magnetic circuits, the latter being arranged two and two in parallel with each other, thus reducing to approximately one-half the length of the magnetic circuit, with all the attendant advantages. Another feature of interest is the plan adopted of obtaining a uniform field of magnetic force. The method of obtaining a uniform flow of current electromotive force for groups of lamps has here been adopted for obtaining a uniform magnetomotive force over the whole face of the pole pieces, as will be more clearly shown in the sections accompanying the description referred to. It is claimed for this arrangement that a maximum output is obtainable from a minimum amount of iron with the least amount of copper and with a practical elimination of losses from leakage. We think this design well worthy of close study.

Diffusion of Light. THE subject of the diffusion of light has not had the attention paid to it which its importance deserves, and it is with pleasure, therefore, that we notice that some one has at last undertaken to clear up the very muddled condition of the knowledge by writing a paper on this important subject. We refer to the paper of Mr. Sumpner, a portion of which was abstracted very fully in our Digest two weeks ago; we reprint part of it in full in the present issue. While every one knows that a light-papered room is easier to illuminate than one having a dark paper, yet no reliable and definite figures have been deduced which enable one to calculate intelligently the effect of diffusing walls and other bodies on the lighting of interiors or on the diffusion of light in general. Mr. Sumpner shows, for instance, that the diffused light may be five times more important than the direct light which produces it, and that in some cases a white reflector is much more economical than a mirror or a ground glass globe for diffusing the light. We would recommend this paper to all who have to deal with light and lighting.

The Telephone Situation. NEVER before since the advent of the telephone have so many letters been received by the editors of this paper in regard to the telephone as during the past few weeks. This has been due to the expiration of the fundamental patents, in which the public feel the deepest interest. Attention is called to an article on the telephone situation which appears elsewhere in this issue, as well as to articles on the same subject published in THE ELECTRICAL WORLD of February 25, 1893, and March 4, 1893. Despite the claims of the Bell Telephone Company there seems to be little doubt but that the telephone, at least in its essential features, will be public property at the expiration of the Bell receiver in January of next year. The exact condition of the telephone litigation situation will depend of course upon the decisions of the courts as to the validity and breadth of the Berliner and Edison patents, but the use of the telephone, even for long distance work, is by no means limited to the microphone transmitter, while microphones of a type entirely independent of the patents in dispute have proved very successful. On the whole the situation is very encouraging and it is to be hoped the time is not far distant when a wholesome competition will place the telephone within the reach of thousands, to whom it is now denied.

Concentric Wiring. IN the very first systems of distribution of the electric light in multiple arc, which we believe was that proposed by De Khotinsky, it was suggested to use the earth as the return circuit, but when electric lighting became a commercial industry this was abandoned and all circuits were very carefully insulated from the earth. Gradually, however, it was found that certain indisputable advantages existing in grounding the neutral wire of a three-wire system; and now the other extreme is reached by the advocates of what is called concentric wiring, who claim that great advantages besides much greater safety arise in grounding one wire of any system, be it three-wire or the two-wire. Thus, after a complete cycle we are led back again to the very first method. This system, to which a reference will be found in our Digest this week, consists essentially of two conductors one outside of the other, enveloping it completely, the outer one being grounded as thoroughly as possible; all switches, cut-outs, etc., are made of metal instead of porcelain, and are grounded. The claims made for it are not unreasonable, and it seems to us that such a system is well worthy more careful consideration, notwithstanding the prejudices against it. It should not be forgotten, however, that, unless a system is grounded thoroughly at both ends and at as many points as possible, leakage currents may arise due to a difference of potential of a few volts between different parts of the wire and the earth, such currents being sufficient to do considerable mischief in corroding the wires. In a system in which such earthed currents are used, as in lighting or railway work, if grounded at all, the wires should be very thoroughly grounded not only at the two ends of that wire, but also at intermediate points; such grounds, furthermore, should be soldered contacts, as one should not trust to mere contact produced by pressure.

Safety Wiring. IN connection with the system of concentric wiring, just referred to, we may be pardoned if we call attention once more to a fact which is not understood and appreciated as much as it ought to be, especially by insurance companies, who are our dictators and rulers in regard to wiring. Some of their rules say that the two wires must be kept a certain distance apart; as a matter of fact, however, it can readily be shown that the closer they are together the safer they are. This may readily be shown by nailing two bare wires on a board and moistening the wood between them; when they are two or three inches apart the leakage current will slowly set the wood on fire; and as this requires but a very small current the fire may be started without blowing the safety fuse. If, on the other hand, they are close together, separated only by a thin layer of insulating material capable of absorbing moisture, the current will become so great that the fuse will be blown immediately, before any charring or ignition can take place. The experiment is such a simple one that those who do not believe this statement can readily satisfy themselves by making an actual test. In making this test it is advisable to put some salt or soda into the water. Contrary to general belief it therefore appears to be much safer to place the wires as close together as possible, provided proper precautions are taken to prevent the accompanying flash from igniting any very inflammable material.

Gen. Thomas Thompson Eckert, President of the Western Union Telegraph Company.

The vacancy caused by the death of Dr. Norvin Green, on Feb. 12, was filled on Wednesday, March 8, by the election of Gen. T. T. Eckert as president of the Western Union Telegraph Company. This selection was certainly not a surprise to any of those most interested, for, since the vacancy was created, all eyes were turned upon General Eckert as the most available and probable successor of the gentleman who so long had occupied this most important position.

Thomas Thompson Eckert was born in St. Clairsville, O., on April 23, 1825, and is therefore now approaching his sixty-eighth birthday. He learned the telegraphic art in 1848, and, in the following year, having been appointed postmaster at Wooster, O., inaugurated what is said to have been the first system of postal telegraphy by receiving the Wade wire into his office, and uniting the duties of postmaster and operator.

Mr. J. H. Wade, at that time building telegraph lines westward, saw in young Eckert's aggressive vigor and industry the man he needed, and, without much hesitation, offered him the superintendence of the Union Telegraph lines, then being extended from Pittsburgh, Pa., by way of the Pittsburgh, Fort Wayne & Chicago R. R., through to Chicago. The construction of this line, which, at its Chicago terminus, comprised the earliest first class city line of poles into Chicago, became at once the pride of telegraph men, and established for Mr. Eckert his first distinct reputation as a constructor of telegraph lines.

At the breaking out of the war Mr. Eckert was associated with J. W. Cledennin, now one of the directors of the Western Union Telegraph Company and the gentleman who has been his lifelong friend; he was engaged in gold mining in North Carolina. Although his business interests were in the South, his sympathies were with the North in the impending struggle, and he at once tendered his services to the government for any position in the military telegraph service. His offer was at once accepted, and he was appointed on the staff of General McClellan as his aide in charge of the military telegraphs of the Army of the Potomac. Having in his younger days been a neighbor and acquaintance of Edwin Stanton, the latter, on his appointment as Secretary of War, at once called upon him for service at the War Department, and appointed him Captain and Assistant Quartermaster in charge of the military telegraph department of the Army of the Potomac. His loyalty, integrity and diligence in such duties brought him into confidential relations with Lincoln, Stanton and the generals of the army, and his eminent services were soon recognized by his appointment as Assistant Secretary of War with rank of Brevet Brigadier-General. In the mean time he had been advanced to the position of Major and Assistant Quartermaster, and his jurisdiction extended as assistant general superintendent of the U. S. military telegraphs to the entire military line comprised within the United States Military Telegraph Department. At the close of the war he was elected to fill the position of general superintendent of the Eastern division of the Western Union Telegraph, which, in the meantime, had absorbed the American system, extending from Maine to Louisiana, through its Southern connection, the Southern Telegraph Company. In this position he began at once the extensive reconstruction of their lines and the reorganization of the management and construction force, thus contributing very largely to the general efficiency of the service. He also paid especial attention to the improvement and perfection of the cable service, taking that department into his own office, where he could give it his own personal attention. The headquarters of the W. U. T. Co. at this time were at 145 Broadway, New York. But the limited space in these quarters being totally inadequate to the necessities, and affording him no suitable opportunity for the work in hand, he conceived the idea and recommended the lease or purchase of the Astor House Building and the addition of stories for telegraph departments, and the establishment in the space not thus occupied of offices, commercial exchanges, etc. In this Mr. Eckert was in advance of the conservative minds of his associates, and the project was not approved. He, however, joined heartily in the plans for the construction of the present building on Dey street and Broadway, but after its completion and before the removal of the offices he accepted a proposition from Jay Gould to assume the presidency of the Atlantic and Pacific Telegraph Company; this was in 1876. During his administration this company, through the extent of its lines, had established a sharp competition with the Western Union, in which it was greatly aided by the advantages possessed by Mr. Gould of interesting large railway corporations in the enterprise.

It was General Eckert who established the universal 25-cent rate east of the Mississippi River, and who, by these means, forced the Western Union company to the acquirement of its rival.

At this time Mr. Gould exacted of Mr. Cornelius Vanderbilt the promise that General Eckert should be made vice-president and general manager of the Western Union Telegraph Company, a new position, but one which no man was better fitted to fill. During the merger of the A. & P. company into the W. U. company, General Eckert was accorded leave of absence, and remained one year in Europe, while Mr. Gould patiently awaited the realization of Mr. Vanderbilt's promise.

But for some reason Mr. Vanderbilt delayed. Mr. Gould, becoming impatient, thereupon recalled General Eckert from Europe and organized the American Union Telegraph Company, to which General Eckert was elected president. The history and growth of these lines are a record of General Eckert's energy and ability, and their importance to the Western Union was made manifest by the latter's efforts to prevent their extension. Their success, however, after four years of operation, enabled Mr. Gould to secure at a fair rate a controlling interest in the W. U. company, and to place himself in a position to enforce Mr. Vanderbilt's promise to him of five years previous, and General Eckert was made vice-president and general manager of the Western Union Telegraph Company.

An interesting episode in General Eckert's career with the A. & P. company, which is characteristic of his energy and ability, was the construction of a telegraph

GEN. THOMAS T. ECKERT.

line between Louisville and Cincinnati, by way of North Vernon, Ind., a distance of 120 miles, in 24 hours. The Western Union company, having some rights in the premises, opposed the construction of this line by the A. & P. company, and it was known that as soon as work was begun an injunction would follow; but Eckert was bound to have the line, and, calling to his assistance his right-hand man, Mr. D. Doren, then general superintendent of construction of the A. & P. Telegraph Company, and now occupying the same position with the Western Union company, he determined upon its accomplishment. Gangs of men were collected in different parts of the country, shipped to Cincinnati by different routes and taken to different hotels. The foreman of each gang supposed that his was the only party that had been employed for the work, the character of which was unknown, further than that it was telegraph construction work. There were some 12 or 15 gangs in all, comprising in the aggregate 150 men. These men arrived in Cincinnati at various times during Saturday, and were instructed to report at the O. & M. depot at 7 o'clock in the evening. Each gang was taken to the depot by a separate route, and each was assigned to a separate car, after entering which they were closely confined so as to prevent a comparison of notes, or the leaking out of the project. Attached to this train also were cars loaded with material sufficient for constructing the line.

As the train proceeded on its way, it stopped at intervals, at each of which one gang disembarked, and so the distance was covered with the various parties, to each of which had been assigned a section, which, by vigorous work, they could cover before Monday morning. As the work was commenced after the closing of the courts and continued through Sunday, no injunction could issue, and the work was completed and the line in operation between the two points before the courts could be applied to to stay the proceedings.

This line was but a link in the chain extending to New Orleans; and the remaining distance, some 900 miles, had been promised by General Eckert and Mr. Doren, to be completed in 90 days from the date the first work was commenced. As a matter of fact, it was completed within the time promised, with the exception of a few gaps, at the crossings of other lines, which delayed them a little, but in 92 days from the inception of the work the 900 miles of telegraph line between Louisville and New Orleans was in actual operation.

General Eckert has the make-up of the engineer or the architect, and had he embraced either of these professions must have become prominent as a leader. He has, indeed, become prominent in these lines, and is now considered one of the best authorities in the country on the architecture and construction of telegraph buildings, and continues to give his personal attention to the planning and construction, both here and elsewhere, of all the Western Union company's buildings, and the technical arrangement of their interior equipment is largely the product of his own ingenuity and judgment.

A Reminiscence of the Convention.

During the recent convention of the National Electric Light Association at St. Louis, an old farmer, with some of the rich mud from the "bottom lands" of Wayback county still clinging to him, wandered into the corridor of the Southern Hotel, where he lost himself among the crowds of Ohm's lawyers there collected. Observing his embarrassment, the ever genial Mr. Fredrois approached and inquired: "Anything I can do for you sir? What would you like?

"Why, thankee kindly, sir; I own up to taking a taste of gin and sugar at home, but never drink when traveling."

This unusual statement aroused Mr. Fredrois' enthusiastic wonder, and the two were soon engaged in conversation.

"Well, sir," said the man from the flats, "Pilot Knob, this State, is as fur's I've traveled, and I was near struck by lightning there and hev taken a great interest in electricity ever since. My hoss was killed outright from under me, and I was that nigh death I was a convert from that hour, and thought I would jest run up here to your experience meeting and lend my testimony, if so desired. Thet hoss, sir, was wuth a good deal to me, full $40, I reckon, and my salvation."

Brother Fredrois was electrified to his core by the Missourian's magnetic force, so he hunted around among his reminiscences for a tale of equal potential, and produced the following, for the truth of which we leave him to vouch: His aunt Mehitabel Volt's cousin, it seems, was once churning during a severe thunder storm. But to use his own words: "Yes, lightning does play strange freaks. Do you know, she had scarcely dashed that dashed dasher twice when a regular Geissler of a flash came and she was almost blinded. However, she could see well enough the lightning strike a cherry tree near the woodhouse, run around the trunk three times, dart over to the pig-pen and back to the woodhouse ridgepole, where she lost it, for it came through the roof and hit the dasher of that churn. It was lucky she had thrown her hands over her head in her fright, for there wasn't enough of that dasher left to take the place of a broom splint in testing that morning's baking of cake. But I almost missed the point of my story. Do you know, sir, that when she looked into that churn, the butter had come and was all ready for working? Churned by electricity; true as Franklin with his key. But I see you looking at that handsome man near the bar door; that's our efficient secretary, who will keep the minutes hereafter by the aid of his new watch; his name's George Porter, and that stout man (you know porter and stout are usually together at the bar) beside him is C. O. Baker, the man who brings us all here, our long-distance transmitter, as it were. His latest invention is one of the wonders of this age. You know the train we came on never stopped once all the way from Jersey City? For water, you say? Well, I guess it got water by induction from the clouds; but Mr. Baker has recently patented an accelerator, by means of which passengers board the train while it is making 50 miles an hour. This accelerator is a little car which runs out from a station and gradually increases its speed until the express comes dashing along and the two run side by side. Then the passengers step on the express from the car, which gradually slacks up and runs back to the station. Money in it? I should say so. It's a regular accumulator."

"Well," laughed the old man, "I should say that if he was much of a train-man, he would have filled that pretty bowl you fellows gave him last night with at least a conductor's punch."

With the usual American contempt for a "Punch" joke, Mr. Fredrois entirely ignored this remark.

"The pretty man by the elevator? Oh, that's Electro-static W. Little, the lady-killer of the East; does it with an electro-leer, you know. He's such a spark the ladies can't offer any resistance to his attractions. You see the tall genius beside him? I suppose you have read

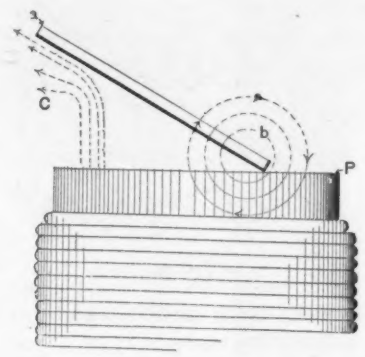


FIG. 3.—ATTRACTION BY ALTERNATING CURRENTS.

in story books of a whole room being lit by a smile from some fair one? Well, he does it easier than that; in fact, in a good deal less time than he takes to tell about it, for I heard him try it once for three hours and a half at Columbia College, New York. His name is Tesla, and among electricians it shines with as much luster as his inventions. Why, man, he can light a room by just hanging a few sheets around it! Zinc sheets, of course; then he waves a wand or presses a button or something, and, whiz—no extra charge—your room is as light as the day of judgment."

"Who's the tall Yankee with the gray beard?" inquired the farmer.

"Why, that looks like Prof. Elisha Gray, of Chicago, one of the master intellects of this country. Gray has about ready a most marvelous creation destined to rival the telegraph in importance. It works this way: The operator at the Chicago end of the wire sends a good recipe, and, do you know, 'way off in Kalamazoo a baked cake drops from the instrument like a hot potato."

"Good land o' love, what a blessing to the kentry!"

"Yes, and talking about food, there's the great ammeater."

"Ammeater—what's that?"

"Sh! he's coming this way; why, he eats a whole am for breakfast every day, and, what's more, takes 'em raw. Ugh! And I've heard he's partial to swan lights and goose livers, too. His capacity is enormous. These electrical men are queer in their tastes. Now, there's De Lamp, of Philadelphia, standing between those isolated plants near the window; he actually refused fowl yesterday, because it was hydraulically pressed turkey with no belt dressing. Next to him is the well known 'Electric Bell,' of Boston.

"That poetic looking man coming toward us is Prof. George Forbes, of Niagara, famous for his well known saying, 'O, what a fall was there, my countrymen!' "

By this time Mr. Fredrois' interior conduit and connecting vacuum needed lubricating, so he hastened toward his friend, Mr. Porter, in order to "obtain the effects of fluorescence," as he technically put it.

The man who did not drink when traveling was then accosted by a small but intelligent newsboy who had been an attentive listener to the above discourse, and whose acquaintance with the members of the electrical fraternity was limited to the descriptive headlines with which the St. Louis papers honored them. He said: "Do you want to know who's the head of this here meetin'? It's Ayer, the lamp-lighter of St. Loo. They say there's lots of electricity in air, so you'd best keep clear of him, old fellow. There ain't one of them others can hold a 32-candle power to him, and he b'longs right here. Then there's Mr. Francisco ——"

"Anything to old San?" asked the Missourian.

"The same," laughed the boy, "and so rich they call his walk the 'Golden Gait.' And there's Henry Hine, who sells condensers; he kin condense a pail of milk a minute wid his machine. I know 'em all, even to the conductor of the train, though some of 'em called him a non-conductor, and then they all larfed, and said, 'Watt's in a name?'

"I seen a book by one of them electrickers this morning. I've forgot his name, but there's a town in Texas called for him, and he's writ a hull book full of new names for electrical things."

The man from Wayback county could no longer control his surprise. "Young man," he said, "haow do you happen to know all these great electric lights?" The boy drew himself up to his full height of four feet five and haughtily answered: "You may have heard of me; I'm the Wizard of Menlo Park, I am, and me name is Thomas Alva Edison!"

A Curious Action of Attraction by Alternating Currents.

BY ELIHU THOMSON.

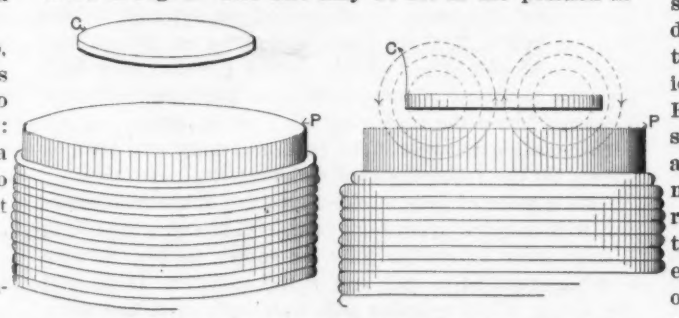
A curious case of apparent attraction of closed circuits in the neighborhood of an alternating magnetic pole, which was found in experimenting on the repulsive effects, is worth recording.

Let P, Fig. 1, be an alternating magnetic pole, produced by a bundle of iron wires surrounded by a coil through which alternating currents are passed, and C a copper disc considerably smaller than the pole end P. As the disc C is approached to P it will, of course, be found that it is repelled, or that a certain force has to be overcome in bringing it nearer and nearer. It will be found, however, that instead of increasing as it nears the pole, after a certain position has been passed, the repulsion diminishes, then disappears, and is at last replaced by an attractive force of considerable amount, which increases down to the position of actual contact with the pole. It is assumed that the disc C be kept parallel to and central with the pole face P.

The explanation of this apparent anomaly is, I think, simple. The attraction appears to be due to the nearness of the disc C to the iron core. Currents are induced in C which, owing to the small diameter, relatively, do not suffer as great lag as when induced in rings or discs which encircle the pole. These currents exert an attraction for the iron of the core which at last becomes superior to the effort of the repulsion, which is feeble. The induced currents in C, in seeking a better magnetic circuit for their induction, cause the disc C to approach the core. The strongest attraction will, of course, exist when the current which energizes the pole P is passing its zero value.

At this time the attraction will be understood by a glance at Fig. 2, where the magnetic effects of currents in C now have free action on the pole P.

A pretty modification of the experiment, and one in which both attraction and repulsion take part, is indicated in Fig. 3. The disc may be set in the position in-



FIGS. 1 AND 2.—ATTRACTION BY ALTERNATING CURRENTS.

clined, as shown, and attraction at b may keep it from being thrown off the pole, while repulsion at a sustains something less than one-half the weight of the disc in the inclined position shown. If the alternating pole be presented in a horizontal direction, it will also be found that the disc will adhere to the pole, and slip down to a position below the centre. If it slips too far down, the attraction is at once replaced by a quick repulsion which casts the disc away from the pole quite suddenly. With the pole completely inverted or facing outward, the attraction will be sufficient, in some cases, to hold the full weight of the disc against the pole.

The Telephone Situation.

Among the numerous letters of inquiry recently received in regard to the telephone situation the following is selected for answer in these pages as being more comprehensive and covering more fully the ground, perhaps, than any other:

To the Editor of The Electrical World:

How far does the expiration of the Blake transmitter and Bell receiver patents affect the telephone monopoly, and how far does this expiration render the public use of telephone apparatus practicable? R. H. V.

To answer this question we must go back a little way into history. The original Bell patent was granted March 8, 1876; this was for an instrument then used both as a transmitter and receiver, but is now almost exclusively used and known as the Bell receiving instrument. In this patent, as we understand it, all that was essential for the transmission of articulate speech was covered, and it is in this sense the fundamental patent and the one which created the art of practical telephony. It, however, was limited, in a sense at least, to a parchment diaphragm, and its full life has, therefore, expired this month without reference to the expiration of foreign patents. This was followed the next year (1877) by another patent covering specifically the metal diaphragm and in this and some other respects more particularly covering the instrument now in use. This patent will not expire by limitation until January of next year. As before intimated the Bell receiver contains within itself all of the elements essential both to the transmission and receiving of electrically transmitted articulate speech. And at the expiration of this 1877 patent there can be no question as to the art being open in every sense to the public. The complications which have given rise to so much discussion are due not to any questions as to the fundamental patents, but to the introduction of other devices which may be looked upon as refinements in the art and not essentials. Among the chief of these is the microphone, or transmitter. Of these the Hunning, which is now used in a modified form on the long distance lines, is already open to the public on account of the expiration of the patent in England, and the Blake transmitter, which is the one almost universally used in this country, on all but the long distance lines, is also open. But the Berliner patents come in as the disturbing element here in that though they were but granted in 1891 they have been held to anticipate all transmitting devices employing variable contact between two electrodes. The legality of this patent remains to be adjudicated before the higher courts, and if finally upheld in the courts of last resort will still have a life extending over some 14 years from the present time. The Edison patent covering more specifically the carbon electrodes would also have about the same time to run, but, as we have seen, the art of telephony is entirely independent of these transmitter patents, and is now open to the public so far as a parchment diaphragm is concerned, and will be open after January of next year in regard to every essential of the instrument now in use. As regards switchboards, much has been said about the patents which still cover these and have years yet to run, but a great deal more has been made of this feature than its importance deserves. The broad principle of electrical switchboards for the purpose of commutating the terminals of electrical conductors is 20 or 30 years old, and was well developed long previous to the introduction of the telephone, and is public property; Improvements in detail especially adapting it to telephone exchange work have been made, it is true. But there are no patents so broad as to preclude the manufacture of effective and convenient switchboards answering in all essentials the requirements of the art.

The Bell receiver is, in fact, in some respects a superior transmitting instrument to any of those especially designed for the purpose, in that it introduces no local disturbances, such as are inseparable from variable contacts. The microphone transmitter is, indeed, a convenience, but, as before stated, by no means an essential For long distance work in telephony, as in other transmissions of electrical energy, high potentials are necessary, and for this purpose the use of the induction coil in connection with the microphone, to transform the local currents of low potential into those of high potential for transmission, was early adopted. But the same effect exactly can be produced by properly winding the coils of the Bell receiver with an additional number of turns of fine wire. It will be remembered that for the first year and a half or two years of the art of telephony the microphone was not used at all. Two instruments exactly alike of the Bell type were employed, one as a transmitter and the other as a receiver. It is not, however, so generally known to what distance a transmitting instrument of that kind is generally effective. It will therefore be a surprise to many to learn that as early as 1879 speech was distinctly transmitted from New York to Yonkers, a distance of 25 miles, and between New York and Philadelphia, a distance of 90 miles, and that in 1883, after the completion of the Postal Telegraph companies lines to Chicago, conversation was carried on during the day time between New York and that city notwithstanding the fact that the wire was grounded at both ends. The wire used in this experiment was one of the regular wires used for telegraphic purposes by the Postal Telegraph Company, and was a compound wire composed of copper and steel, the former metal being employed to add conductivity, and the latter to give strength to

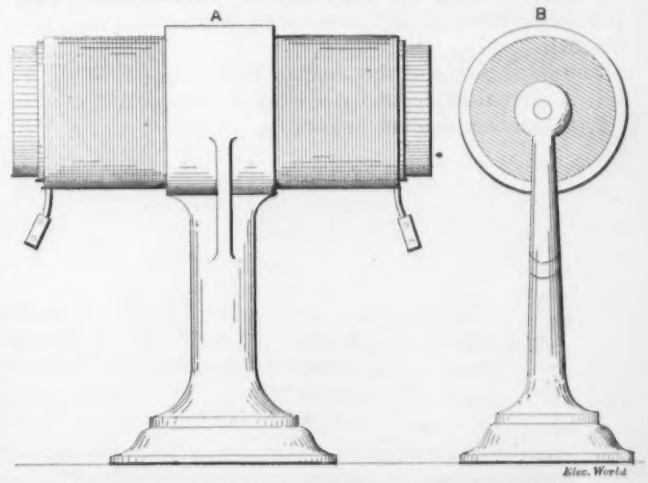


FIG. 4.—ATTRACTION BY ALTERNATING CURRENTS.

the wire. Our recollection is that it was a No. 8 B. W. G. Conversation was also carried on at about the same time between New York and Cleveland, the Bell instrument being used in all these.

As regards the expiration of this Bell receiver patent the Bell people claim that it is not open until next year. Assuming that this is true, it is questionable whether in the very short life remaining the Bell Telephone Company would deem it a profitable undertaking to bring suit against manufacturers and users of the in-

strument at the present day, in view of the fact that the patent would almost certainly expire by limitation before adjudication could be reached, and that even in case of a favorable result of their suit, they could derive little or no benefit from the same. Then again, in reply to the question that has also often been asked, Would it be possible for a company to commence operations at the present time, looking to the establishment of a telephone exchange business? it may be said that if a company should start out now with that intention they could

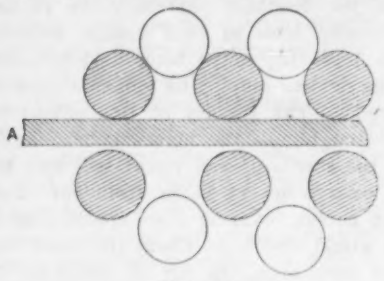


Fig. 3.

scarcely hope, even with the most vigorous prosecution in their construction, to have their plant ready for operation before the expiration of the metal diaphragm patents of 1877. In the opinion of many who have given the matter thought, too much stress has been laid on the supposed monopoly that the existing companies would maintain, by reason of their existing franchises, plants and acquired business. But aside from this there is believed to be an immense field for telephone work outside of the telephone exchange business. This, by reason of the patents, has been entirely neglected heretofore, and will doubtless prove a rich field for purely business enterprises in the future. For long distance work the telephone cannot compete on equal terms with the telegraph, for the reason that the speed of transmission is many times slower than that possible by the multiplex systems already in use, and the expense therefore necessarily attaching to the transmission of a message must probably always remain a bar to its general adoption.

Conductors and Insulators.—II.

BY REGINALD A. FESSENDEN.

The reader is probably familiar with the modern theories of electricity, as expounded by Prof. Lodge and other writers, so that a very brief statement of them will be sufficient.

The following mechanical analogy (with one unimportant modification) is that given by Lodge in his book on "Modern Theories of Electricity," and is really a modified form of Maxwell's representation.

The rod A (Fig. 3) represents a conductor imbedded in a dielectric consisting of a number of balls. These balls are of two kinds—black and white—the black rotating in the opposite direction to that in which the white do. The coefficient of friction between these balls and the ether, or between one another, is very great; but between the conductor and the balls it is almost negligible, and the better the conductor the less the friction. Imagine an ion in an electric battery bringing a quantity of the ether to the end of the conductor A. This sets in motion that ring of black balls, which immediately encircles A. This turns the rings of white balls, which touch it, and these in turn set in motion other rings of black balls, and so the magnetic disturbance is propagated all through the dielectric. Those rings of black balls, which lie contiguous to the conductor, push the ether in the conductor along, and so the result is a stream of ether in the conductor, to a rotation of balls, or a magnetic field, in the dielectric. This continues till the ether has been advanced all along the conductor by just the amount which the ion added to the conductor. By this mechanism, all the phenomena of induction may be imaged.

The chief points of this modern theory are:

1. A current of electricity is ether in motion.
2. Magnetism is ether in rotation.

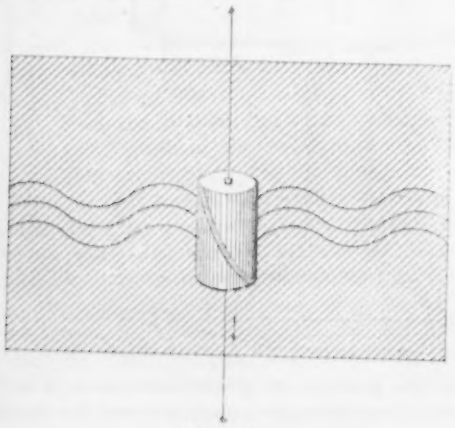


Fig. 8.

3. An electrostatic charge produces a strain in the ether.

4. The energy is supplied from the dielectric and flows into the conductor to be dissipated there in work or heat in the same way as waves keep their energy, till they strike the shore, the quantity passing through unit area of a plane perpendicular to that plane in which the lines of electric and magnetic force lie, being one-fourth time the product of the electric into the magnetic intensity, into the sine of the angle between them.

It is evident that a mechanical representation could also have been made by supposing the ether in the conductor to be rotating, and the balls representing the dielectric to be moving or flowing round the conductor. But while analogous effects could be produced in this way, Lord Kelvin has shown that the magnetic rotation of polarized light must necessitate a rotation of some kind around the lines of magnetic force; so we chose the former mechanism.

It may be that the electric current is actually produced. For, take our complex ether, described above, and suppose that when two of the vortex filaments approach each other, they will repel each other, if their contiguous sides are moving in opposite directions, as in Fig. 4, and attract each other, if moving as in Fig. 5 (the filaments being shown in cross-section). Then, if a portion of the ether in the positive direction moves, it will make those filaments, whose nearer sides are moving in the positive direction, come closer to the conductor, and these filaments will repel each other, so as to allow filaments rotating in the opposite direction to come in between them and take the part of idle wheels, as Maxwell puts it. These filaments will finally react on other portions of the ether in the conductor, and we shall get a current and have energy stored up in the dielectric as before. The only difference between this view and the mechanical analogy given above is that, instead of having the conductor surrounded by a complete ring of balls

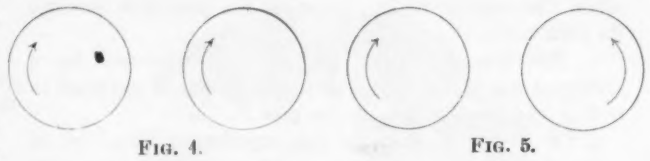


Fig. 4. Fig. 5.

(Fig. 6), we have a ring compounded of portions of various vortex filaments, lying curved or tangent to the wire, as in Fig. 7, their shape depending on the amount they are stretched out of the normal position they had, and the resultant effect of all these portions of vortex filaments being the equivalent of a vortex ring.

The relation between light and electricity can best be shown by the following illustration:

Take a piece of jelly, molded into the shape of a cylinder, with a spiral groove cut in it. Oil it and imbed it in a large mass of similar jelly, as shown in Fig. 8, with a string attached to each end of the cylinder. If we pull the string A the cylinder will rise, and, as it has some friction on the jelly in which it is imbedded, those layers which are nearest to the jelly will be pulled up, too. These layers will communicate the motion to the next outside layers, and so on, and the disturbance will travel outward at a rate depending on the elasticity and density of the jelly. If the cylinder be now pulled down by the lower string, the motion adjacent to it will be in the oppo-

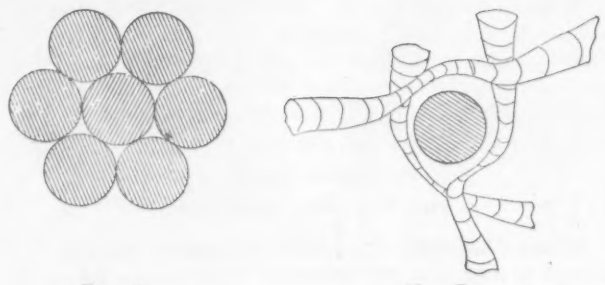


Fig. 6. Fig. 7.

site direction to that producing the first disturbance, and the result will be a wave, as shown in Fig. 8, which is a vertical section of the waves in the jelly, etc. These are waves of electrostatic disturbance.

At the same time that the cylinder is pulled up, it will tend to produce a twist in the jelly round its vertical axis. This twist will be in one direction when the cylinder is pulled upward and in the other when it is pulled down, and this twist disturbance will travel out like the former one, but in a horizontal plane, so that on reversing the pull the motion will at any instant be in different directions in different parts of the jelly, and we have a second set of waves, perpendicular to the first, as in Fig. 9, which is a horizontal section of the jelly, cylinder, etc. These represent the waves of electromagnetic disturbance. The actual method of producing these vibrations is to take conductors of a certain self-induction and capacity, and let a spark pass from one to the other. If, in our previous illustration, we replace the string and top of the cylinder by one copper wire and the bottom string and bottom of the cylinder by another copper wire, leaving an air gap between them, as in Fig. 10, and replace the jelly by ether, then, when the spark passes between the copper wires, it will consist of a very rapid flow, across and back, of current (provided the capacity and self-induction are just right). This motion back and forth of the ether, or, as we call it, this rapidly alternating current, produces waves in the ether similar to those which the up and down motion produced in the jelly, and these waves are waves of light, but of such a long wave length that we cannot see them.

States of Matter.—The different states of matter may be defined as those states which a given collection of atoms can be made to appear in, by giving or taking from them energy only. They are:

1. Solid.
2. Fluid.
3. Vapor.
4. Gas.
5. Solution.
6. Plex.

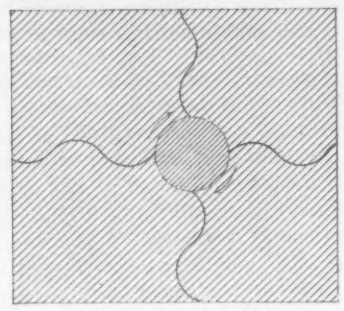


Fig. 9.

(The word "plex" being used instead of "collection of atoms in a polymerized state.")

In solids at any temperature above absolute zero the atoms have a certain amount of kinetic energy, and would be driven apart but for the force which holds the atoms together. What this force probably is we shall see later. There may be also, under certain conditions (which are present when one substance is dissolved in another), a second force tending to draw the atoms apart from one another; i. e., a greater attraction between two dissimilar kinds of atoms than between the atoms of either kind. Thus, when we put sulphuric anhydride in water, there may be a greater attraction between a molecule of sulphuric anhydride and one of water, than between two of water or two of sulphuric anhydride. The result would be a drawing apart of the atoms of each substance in the same way as they are driven apart by heating. The ratio between the attractive and repelling forces is naturally one of the chief factors in change of state. It may be expressed by the fraction: Cohesive force of atoms (repelling force arising from kinetic energy of atoms and force drawing asunder, due to attraction of other atoms). If this fraction is greater than unity, the substance is a solid or fluid. What the exact value of the fraction is when a substance passes from the solid to the fluid state is not known, and, while its value is possibly the same for all simple elements, it varies when they are plexed or polymerized. (It may be noted that all the unpolymerized or simplex elements expand about 2 per cent. of their length between absolute zero and their melting point, whatever that may be.)

When the fraction is less than unity, the substance is a vapor or a gas. The distinction between the two is this: When the kinetic energy of the atoms or molecules is not so great, but that when the atoms are made to approach one another by applying pressure externally their cohesive force becomes sufficiently increased to overcome the repulsion, due to the motion of atoms or molecules, and the fraction mentioned above becomes greater than unity, then the substance can be turned into a liquid by pressure, and it is called a vapor. When, however, no amount of externally applied pressure can do this, the repulsive force remaining greater than the cohesive force, even when the atoms are pressed together so as to touch each other, the substance is called a gas. It is evident that in most cases there will be a certain value of the kinetic energy of a substance, so that, when its kinetic energy is greater than this value, the substance is a gas, and, when less, it is a vapor. As temperature is measured by the kinetic energy of the atoms or molecules of the substance, this value will correspond to a certain temperature called the critical temperature.

When we dissolve a lump of sugar in a tumbler of water, a wonderful thing happens, whose interpretation is still in dispute. But there is such a vast mass of evidence in favor of the disassociation theory that we may with every probability assume it as correct. There is a rival theory of Mr. Pickering, according to which, when

Fig. 10.

a substance is dissolved, it forms a great number of hydrates of different compositions, and that, as in general, a mixture of two substances gives rise to something half way between them—the mixture is a fluid. Thus, if we put sulphuric acid into water, it forms with the water a mixture of H_2SO_4, $H_2SO_4—H_2O$, $H_2SO_4—2(H_2O$, etc

and this mixture is fluid. But this theory has not met with much favor.

The disassociation theory (though the name is rightly applied to a single part only of the theory about to be described under this head) is as follows, with some modifications of the writer's. These modifications do not affect the main theory, but are only introduced to explain the heating which generally takes place on solution, the increase of surface tension, etc.

The atoms of a lump of salt are held together by their cohesive force, and this, since the substance is a solid, evidently overbalances the repulsive force due to the kinetic energy of the molecules of NaCl. When we put the salt into water, however, there is added to the repulsion which the molecules exert on one another a

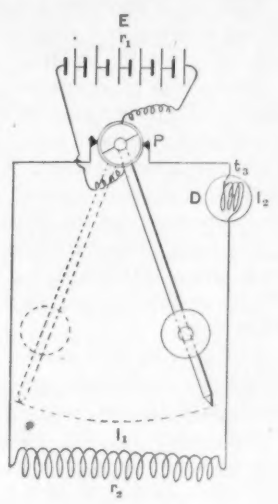


FIG. 1.

pull, due to the attraction of cohesion between the molecules of NaCl and H_2O. This combined push and pull overbalances the cohesion of the molecules of NaCl, and they move apart from one another, just as they would have done had the salt been put in the tumbler by itself and heated till it turned to vapor. The salt has really turned to a gas as it dissolves; the only difference in these two ways of turning a substance into a gas, by solution and by heating, is that in the former case the molecules are made to separate by a combined push and pull, and in the latter by a push alone, which, of course, must equal the combination of the push and pull.

But, it may be asked, a gas exerts certain definite pres-

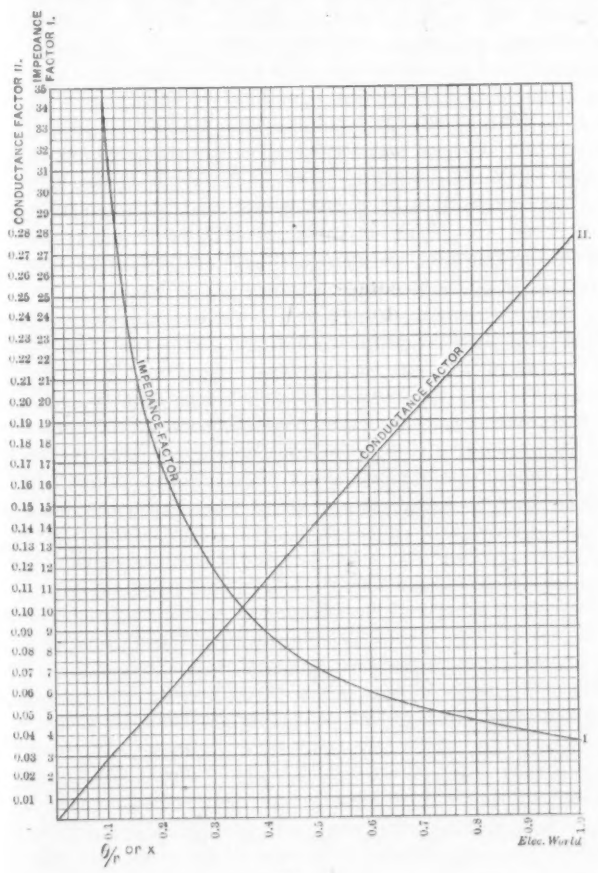


FIG. 3.

sure at any definite temperature. It is also disassociated if we heat it still more; i. e., the molecule of NaCl becomes two atoms; one of Na, the other of Cl, the two repelling each other so strongly as the substance becomes more and more heated that they finally become separated; does a solution show these phenomena? As we shall see, both these are present in solutions, the pressure can be exactly measured and is found to correspond exactly to that calculated, and it varies in the same way with temperature; the disassociation can be observed and measured, and we learn the wonderful fact, for the knowledge of which we are indebted to the work of the great German chemists Hiltorf, Arrhenius, Ostwald and Clausius, that it is only those solutions in which the dissolved substances are disassociated that conduct electricity.

(To be continued.)

On the Current Strengths in Simple Circuits Containing Resistance and Inductance under Periodic Impressed Electromotive Forces of the Rectangular Wave Type.

BY E. A. KENNELLY.

It is so customary to treat currents and electromotive forces in alternating current circuits as sinsuoids, that cases of periodic current distribution that are not simple harmonic time functions sometimes fail to attract attention.

Fig. 1 represents a single electrically conducting circuit of total resistance $r_1 + r_2 + r_3 = R$ ohms, and total non-ferric inductance $l_1 + l_2 = L$ henrys, kept closed through a battery of uniform E. M. F. E volts, so that the steady current through the circuit, and measured by the electro-dynamometer D, is $C = \frac{E}{R}$ ampères by Ohm's law. If now the pole-changer P is made to reverse the battery regularly every θ seconds, what will be the current indicated by the dyna nometer, and how will it vary with the interval θ? The pole-changer in the figure is represented as attached to a pendulum in order to secure regularity of reversals, but it might be operated by uniform rapid manipulation as in a quadruplex pole-changer sending dots, or the reversal might be effected mechanically in a variety of ways.

Since the answer to this question is not generally known, and possibly has not been published, its consideration here may not be unwarranted, and the case is well within the province of practical applications.

We may assume that the pole-changer is in perfect adjustment, so that neither the short circuiting of the battery nor the opening of the circuit at reversal lasts more than an inappreciably small interval of time. Also that the rapidity of alternation relatively to the size of conductors in the circuit is not so great that any additional virtual resistance is encountered, owing to incomplete penetration of the current into the substance of the wires.

The periodic E. M. F. impressed upon the circuit is then of the rectangular wave type indicated in Fig. 2, and the intervals of time represented by O A, A B, B C, etc., are all equal to the semi-period θ.

It can then be shown that the effective current in the circuit is reduced from $C = \frac{E}{R}$ the current when the pole changer is arrested, to

$$C = \frac{E}{R}\sqrt{1 - \frac{2}{x}\left(\frac{\varepsilon^x - 1}{\varepsilon^x + 1}\right)}$$

where E is the base 2.71828 ...., and $x = \frac{\theta}{\tau}$, τ being the time constant $\frac{L}{R}$ of the circuit. The quantity under the radical sign is the factor—always less than unity— by which the current is reduced with alternation, and may be called the conductance factor. Its reciprocal or

$$\frac{1}{\sqrt{1 - \frac{2}{x}\left(\frac{\varepsilon^x - 1}{\varepsilon^x + 1}\right)}}$$

may be similarly called the impedance factor, since it represents the coefficient of virtual increase in resistance. With this formula the following table is obtained:

x	Cond. factor.	Imp. factor.	x	Cond. factor.	Imp. factor.
0.1	0.02899	34.49	2.5	0.5659	1.767
0.15	0.0435	22.97	3	0.6297	1.588
0.2	0.0578	17.3	4	0.6944	1.440
0.3	0.0843	11.87	5	0.7782	1.285
0.4	0 1133	8.825	6	0.8177	1.223
0.5	0.1430	6.991	7	0.8453	1.183
0.6	0.1697	5.892	8	0.8658	1.155
0.7	0.1969	5.078	9	0.8818	1.134
0.8	0.2234	4.477	10	0.8945	1.118
0.9	0.2496	4 006	20	0.9259	1.080
1.	0.2753	3.632	30	0.9488	1.054
1.5	0.3914	2.555	40	0.9662	1.038
2.	0.4883	2.048	50	0.9794	1.021

From this table the curves in Figs. 3 and 4 are obtained. Fig. 3 covers from $x = 0$ to $x = 1$, and Fig. 4 from $x = 1$ to $x = 50$. In Fig. 3, when $x = 0$, which represents the limiting condition for very rapid alternations, the conductance factor vanishes, or the current in the circuit reduces to zero. As the contact time θ increases, the conductance factor advances along a nearly straight line, until with $x = 1$ it, or $\theta = \tau$, so that the contact timeis equal to the time constant, the conductance factor reaches 0.2753, and the current is 27.5 per cent. it of the full value when the pole-changer ceases to vibrate. From $x = 4$ to $x = 12$, the impedance and conductance curves bend rapidly, but beyond this point the change is very slow. When $x = 50$ or $\theta = 50\,\tau$, the effective current is only 2 per cent. less than the full current without reversals. In such cases if θ ceases to be a small fraction of the vibration period of the suspension in the dynamometer, the latter's indications will cease to be steady, but will pulsate with the current. The instantaneous current strength at any time after steady vibration has been well established it, and at an interval t (less than τ after any reversal is

$$c = \pm \frac{E}{R}\left\{1 - \frac{2\varepsilon^{-\frac{t}{\tau}\theta}}{1 + \quad}\right\}$$

and this would be the dynamometer indication if the moment of inertia in its suspension was small enough to eli m. inate retardation in its indications.

As an example, suppose a battery of 50 volts, and 7 ohms internal resistance, reversed 20 times per second (10 complete cycles) by a perfectly adjusted pole-changer into a circuit with 3 ohms and 750 millihenrys (including the dynamometer). Find the effective current strength.

Here $L = 0\ 75$, $R = 7.0 + 3.0 = 10$. $\therefore \tau = \frac{L}{R} = \frac{0.75}{10} =$ 0.075 second. Also, $\theta = \frac{1}{20} = 0.05$ and $\frac{\theta}{\tau} = \frac{0.05}{0.075} = 0.6$, for

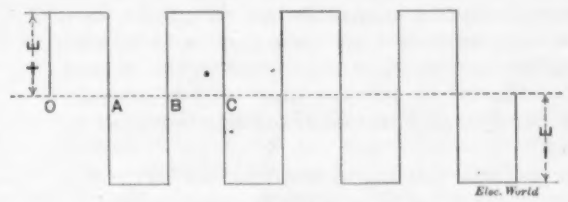


FIG. 2.

which curve II., Fig. 3, shows a conductance factor of 0.1875, or an impedance factor of $\frac{1}{0.1875} = 5.33$. The steady currents with arrested pole-changer would be $\frac{50}{10} = 5$ ampères, and the effective vibratory current would be 18.75 per cent. of this, or 0.9375 ampère.

Electrostatic capacity has been assumed absent from the circuit, and its influence may be left for future consideration.

The Westinghouse Separable Lamp.

In a letter to "The Engineer," Mr. Hiram S. Maxim relates that in the spring of 1881 a consultation was held by the officers and mechanical experts of the United States Electric Lighting Company at New York. The Edison patents were carefully gone into, and Mr. Maxim gave it as his opinion that if the Edison patents were ever sustained it would be on the narrowest kind of a claim, such, for example, as the combination of a slender carbon mounted in a high vacuum, platinum conductors melted into glass, and with the globe all in one piece, It was decided that Mr. Maxim should make some specimen lamps, and have them ready in case the Edison patents should be eventually sustained on these grounds. He accordingly made some lamps in two pieces exactly, he says, after the manner of the new separable lamp. The specific lamp referred to as the new separable lamp was patented by Mr. Maxim in the United States, Sept. 13, 1881, the application being filed April 25, 1881. Mr. Francis Jehl writes us that in a work by A. Merling

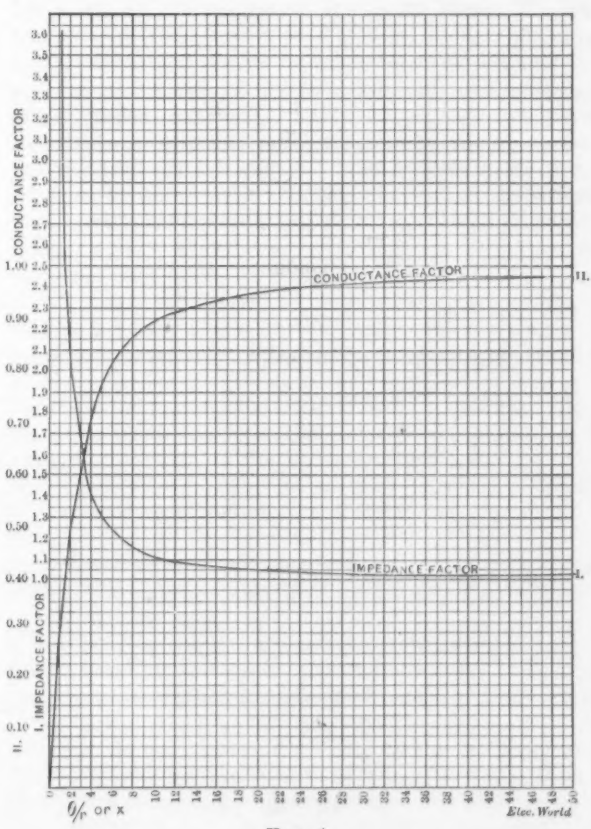


FIG. 4.

(1882), p. 393, it will be found that a glass blower, Dr. L. K. Boehm, of New York, describes a lamp similar to the "separable" lamp.—Lond. Electrician.

Appreciation.

The following communication, recently received from Edgar L. Larkin, professor of astronomy and physics, at Knox College, Galesburg, Ill., needs no comment.

"The editors of The Electrical World have sounded the keynote of success. The prevalent idea in the West was that The Electrical World could not be made any better than it has been all along, but the addition of Carl Hering's department, wherein the electrical literature of all nations is ransacked for the satisfaction and benefit of the public, makes the great journal perfect. Only one fault can now be found with the World; that is, in its old fogy and obsolete name. Change it at once to The Ether World."

The Most Economical Age of Incandescent Lamps.*

BY CARL HERING.

It is generally supposed that it is an advantage for incandescent lamps to have a long life; the object of this paper is to show that this is a delusion, and that it is not substantiated by facts, but that on the contrary under normal conditions a very much shorter life represents an actual gain in dollars and cents; or, in more homely language, if the lamps do not die a natural death, it is more economical to break them at a comparatively early date than it is to keep them in use. The results obtained in the present deductions are so different from what is generally believed that they will doubtless be discredited by many.

At the June meeting of this Institute last year a very able and valuable paper† was presented by Prof. Thomas and Messrs. Martin and Hassler, on "The Life and Efficiency Test of Incandescent Lamps." This paper gives a very complete life history in the form of data and curves of representatives of almost all the incandescent lamps made in this country. With this very complete and reliable data as a basis I have endeavored in the present paper to deduce some figures to show what the best life of a lamp is, everything considered. It is well known that lamps deteriorate and blacken with age, becoming less efficient, and it is therefore an important question to know at what age they should be replaced by new ones; it is this point which the present paper is intended to answer.

The method by which the best age is to be deduced is the new and very rational one suggested by Mr. O'Keenan, and described in "L'Industrie Electrique," Nov. 25, 1892, page 510, also in The Electrical World, Dec. 24, 1892, page 404. As it is fully described in these articles I will merely state it briefly here. Calculate for each hour in the life of a lamp the total quantity of light given off by it in candle power hours from the time the new lamp was first started, similarly calculating for each hour in the life of a lamp the total cost of this light, that is, the original cost of the lamp added to the cost of all the energy consumed by it from the time the new lamp was first started up to that particular hour. Now it is evident that if for each hour in the life of a lamp we divide this total cost up to that hour by the total quantity of light up to that hour, we will obtain the average cost of a candle power hour of light from the beginning up to this hour. From this final data it can be readily shown at what age this total average cost is the least. If based on actual measurements of the lamp made throughout its life, it is evident that this method will give the most rational and only strictly correct way of determining the real cost of the light actually produced; the only factor which it does not include is the interest on the cost of the lamp and power which evidently are negligibly small. It includes the effect of the blackening of the bulb and of the lowering of the efficiency. It should be distinctly understood, however, that this method is based on the actual amount of light produced, and on the actual cost of the power; whenever, therefore, either or both of these factors are not of importance, the results deduced here are also of less importance. I desire to emphasize this as it will doubtless be claimed by many, and with right, that the diminution of the light is of less importance to some consumers than the cost of a new lamp would be.

Having given the candle power and the power consumption of a lamp throughout its life, any one can by this method deduce the final results as described. In the present case, however, the work, which is somewhat tedious, is greatly simplified by taking the data from Table V. in Prof. Thomas' paper, giving the watts per mean candle power. The data are given here in Table I. for the seven most important of the thirteen makes of lamps; the last column, giving the average, is the average of all of the thirteen lamps of that paper, and not of the seven which we have here taken as the most important. By using the watts per 1 c. p. it is evident that the candle power curve in the present calculations becomes a straight line, thus reducing the work by more than one-half.

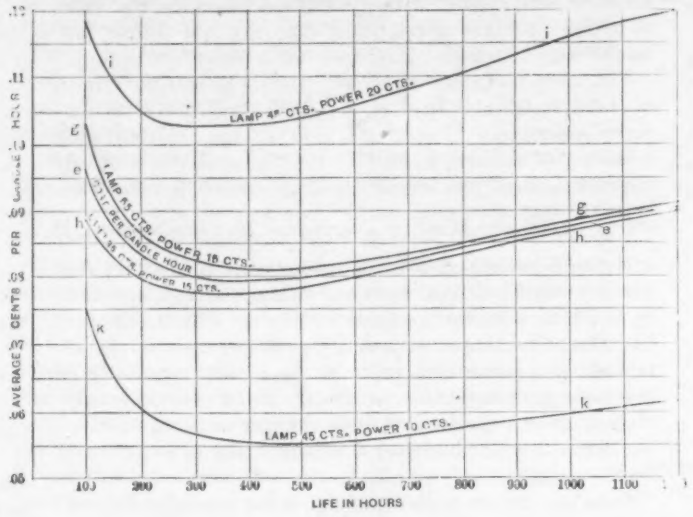


FIG. 2.

TABLE I.

Hours.	Watts per mean horizontal candle power. A.	B.	F.	G.	K.	L.	M.	Av.
0	3.9	4.4	4.1	4.2	3.9	3.8	4 8	4.2
100	4.3	4.8	4.3	4.6	4.3	4.2	4.7	4.5
200	4.6	5.1	4.6	4.9	4.6	4.6	4 7	4.8
300	4.9	5.4	4.9	5.0	4.8	4.9	4.8	5.0
400	5.2	5.6	5.1	5.3	5.0	5.2	4.9	5.3
500	5.5	6.1	5.5	5.5	5.2	5.5	5.1	5.6
600	5.8	6.4	5.8	5.7	5.4	5 8	5.5	5.9
700	6.1	6.7	6.1	6.0	5.6	6.1	5.8	6.3
800	6.4	6.9	6.4	6.3	5.9	6 3	5.9	6.6
900	6.7	7.1	6.6	6.6	6.2	6.4	6.1	6.8
1,000	6 8	7.1	6.8	6.7	6.4	6.2	6 1	6.8
1,100	7.0	7.2	6.7	6 8	6.5	...	...	7 0
1,200	7.1	7.2	6.7	6.7	6.5	...	...	7.0

To illustrate the method let us deduce the results given for the average lamp in the last column. Instead of calculating the results for every hour, which is a very tedious process, it is sufficiently accurate to do so for every hundred hours. From the last column of Table I., calculate for each hundred hours the total kilowatt hours consumed per candle up to that age; the result gives the curve a, Fig. 1. Multiply these values by the cost of a kilowatt hour of energy; fifteen cents is the price assumed here; this gives curve b. Add to these values the original cost of the lamp per candle; that is, the total cost of the lamp divided by the candle power at the start; this gives curve c, which is evidently parallel to curve b. Draw curve d, representing the total candle power hours from the start; in this case this line will evidently be straight; it would be curved if the watts consumed by the whole lamp, and if the whole candle power, had been used instead of the watts per one candle. Curves c and d are those sought for. These curves are evidently the integrals of those represented by the numbers in the table. The process of integrating is effected most readily by purely arithmetical means, as described above; that is, by simply calculating the totals for each hundred hours, and it can therefore be performed by any one without a knowledge of algebraic integration. These curves, however, need not be plotted; they are given here only to illustrate the method. Now, divide each ordinate of the cost curve c by the corresponding ordinate of the light curve d, and the result is the curve e, which is the final curve sought for.

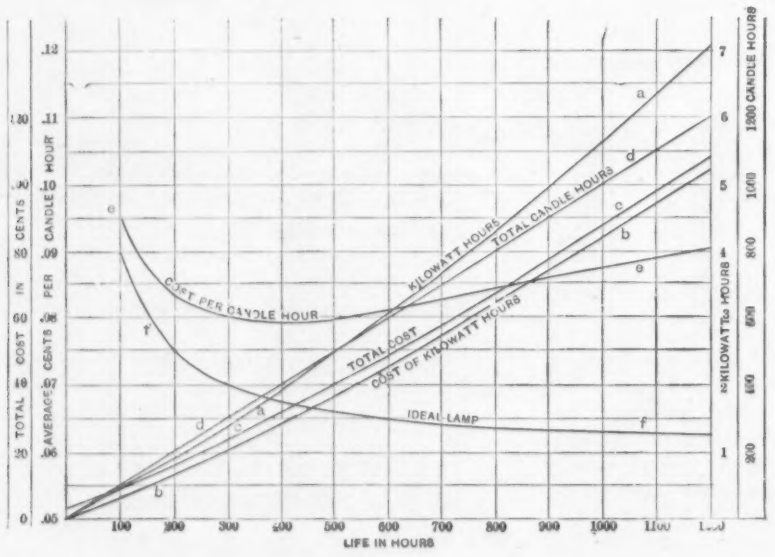


FIG. 1.

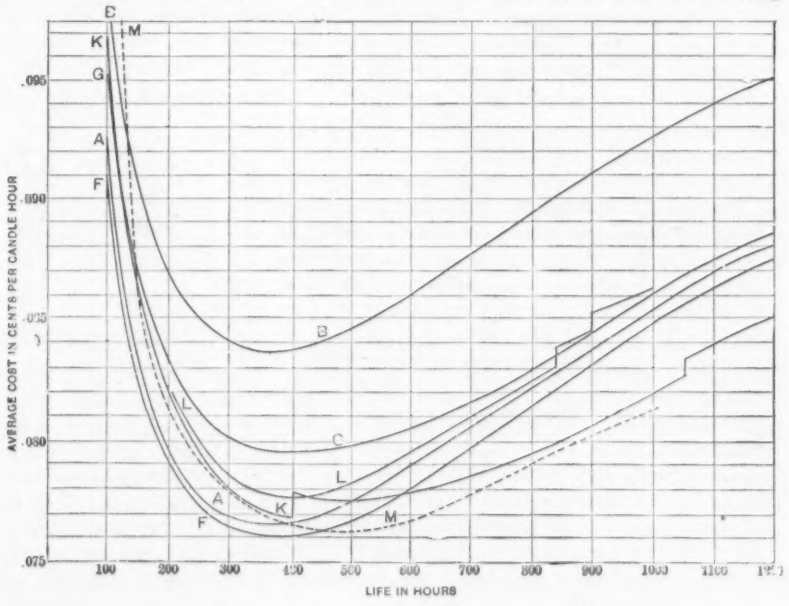


FIG. 3.

The curve e gives for each age the cost of a candle power hour of light; that is, the average cost for the whole time from the time the lamp was first started up to that particular hour. This is the curve which gives us the final results. The interesting feature about it is that it has a minimum point at about 400 hours, which means that at the end of 400 hours you are paying the least for a candle power hour of light; that is to say, your light is then the cheapest during the whole life of the lamp, all things considered. If you continue to use those lamps longer than 400 hours, the average price for the light will again increase, and will continue to do so. Strange as it may seem, therefore, it is more economical to break the lamp at that age rather than to continue running it, even though this means buying a new lamp. This result will naturally be discredited by many, but it is nevertheless true, always remembering that we are concerned with the cost of a candle power hour of light under normal conditions and over an indefinite period. If the amount of light is of no great importance, but the price of the lamp is, then run them until they die a natural death, the same as if the power cost nothing. If your lamp costs nothing, but your power does, then replace them as often as possible. The effect of different relative costs of lamps and power will be discussed later. The data assumed in this curve is that the average lamp costs 45 cents, and the power costs 15 cents per kilowatt hour; the latter figure was obtained from a well known central station manager as a fair average for 110-volt continuous current circuits from central stations or for private installations of about 500 lamps; for installations of less than 500 lamps the cost will be greater, and for more it will be less.

As this curve must always have a minimum point for lamps which deteriorate, there is no question that there is such a minimum value in the cost of the light. Mr. O'Keenan calls this point by the appropriate name "smashing point." To show the results of an ideal lamp, curve f has been drawn. This ideal 16-c. p. lamp, costing 48 cents, and consuming 4 watts per candle, is supposed not to blacken or to change in any way. It is evident that in this case there will be no minimum point, and the longer such a lamp is run the cheaper the light is, although after a few hundred hours the cost diminishes very slowly, being practically the cost of the power only.

To show what the curve e really means in dollars and cents, let us calculate an actual case. If run 1,200 hours the average cost per candle power hour is .0903 cent, or a total of 108.4 cents per candle for 1,200 hours. A 16-c. p. lamp, therefore, represents a total cost of $17.344 for power and lamp, assuming for the sake of simplicity that it continues to give 16 candle power. If stopped at 400 hours, the cost of the light is only .0792 cent per candle hour, or a total of 31.7 cents per candle for 400 hours; if renewed three times in the 1,200 hours, the cost will be 95.1 cents, or $15.22 for 16 c. p. This shows that replacing the lamp after every 400 hours represents an actual saving of 13.3 cents per candle during a period of 1,200 hours, or a total of $2.12 saved per 16-c. p. lamp every 1,200 hours. This amount of money represents the cost of almost five lamps at 45 cents, which might be interpreted so as to show some very curious results, namely, if you bought eight lamps originally, used only three of them for 400 hours each and threw the other five away, it will, in the long run, cost you the same as to buy one lamp and run it for 1,200 hours, assuming that you are paying for light actually received. As the cost of the light at 400 hours is over 12 per cent. less than that at 1,200 hours, it is an actual saving of 12 per cent. in dollars and cents if the lamps are replaced every 400 hours.

Another curious result which it will be hard for many to believe is shown by the fact that the curve e cuts the .09 line at 1,200 hours, and also at about 130 hours, which shows that the light costs just as much whether the lamp is broken at 130 hours or run for 1,200 hours. The curves being flat near their minimum points shows that it makes practically no difference (always remembering that we are considering the cost of a candle power hour of light) whether the lamps are replaced every 300, 400 or 500 hours. It might at first be thought that at 300-hour renewals the lamps will make the cost greater

* A paper read before the American Institute of Electrical Engineers.

† THE ELECTRICAL WORLD, July 16, 1892.

than at 500; but this is not the case, as the curve includes the cost of these new lamps. The explanation of this is that we are considering a constant amount of light, and if run to 500 hours, more lamps must be used to give the same amount of light owing to their reduced candle power. Of course, in practice, they will be renewed at 500 instead of 300 hours, because the difference in the light would be noticed less than the price paid for the more frequent renewals.

Another interesting and somewhat surprising result which may be deduced from the curves is that an ideal lamp of 16 c. p., which remains constant, may cost originally as much as $5.75, and will then give precisely as cheap light during 1,200 hours as the existing lamps, and even then it will be cheaper during the next 1,200 hours than the others. An ideal lamp, equal to the others at 400 hours instead of 1,200, can cost as much as 75 cents, and will even then be considerably more economical after those 400 hours. This theoretical deduction only goes to show how very great the value in dollars and cents is of a lamp which remains constant.

To show the effect of the price of the lamp and the price of the power, the curves in Fig. 2 have been drawn. Curve e is, as before, that for the average lamp costing 45 cents, while the power costs 15 cents per kilowatt hour. In curves g and h, the cost of the lamp was taken at 55 and 35 cents, respectively. They show that the minimum point is reached only about 50 hours later when the lamp is 10 cents dearer, and only about 50 hours earlier when it is 10 cents cheaper. The minimum cost is about 2½ per cent. more in the first case, and 2½ per cent. less in the second. The cost of the lamp, therefore, makes comparatively little difference in the best age of the lamp; it affects the cost considerably more at 400 hours than at 1,200 hours, where it is practically insignificant.

If for the same price of the lamp, namely, 45 cents, the cost of the power is taken at 20 and 10 cents, the resulting curves will be i and k, respectively. This shows that the minimum point is about 100 hours earlier in the first case and 100 hours later in the second. This point is furthermore more decided when the power is more expensive (see curve i), showing that for expensive power it is very much more important to replace lamps earlier, while for cheaper power it will make less difference. For cheap power with cheap lamps the position of the minimum point with respect to time will be altered very little from that of the mean curve e; this is also true for expensive lamps with expensive power. The five curves show the following: That even for considerable ranges the best age remains at between 300 and 500 hours; that the effect of the cost of power is much more important than that of the price of the lamps; that the latter is not of so much importance as is generally believed. All the curves show that while there is a minimum point, it is not very definitely located as to time; that is, it makes but very little difference if the lamps are replaced at 300, 400 or 500 hours, but after that the difference becomes apparent.

So far, we have been considering the average of all the lamps in Prof. Thomas' paper. In order to show the relative differences as well as the absolute values for the different lamps, the curves in Fig. 3 have been drawn for 7 of the most important of the 13 lamps; they refer, though not in order, to the Thomson-Houston, Packard, Edison, Beacon, Perkins and Pennsylvania lamps. The letters of reference are the same as those in Prof. Thomas' paper. He selected these seven as the most important, and gave me the price of each lamp. These prices were divided in each case by the initial candle power of each make, as given in that paper, to obtain the cost prices per candle. These candle powers were as follows: A = 16.0, B = 13.1, F = 14.2, G = 17.1, K = 17.0, L = 13.2, M = 12.5.

A comparison of these curves with those in Prof. Thomas' paper wil show the effects of certain features. Such a comparison would be far more interesting and instructive were we allowed to know the names of each one of the lamps.* We can merely say here that B and G are evidently poor lamps, while M, F and A are the best, notwithstanding that one of the M's died very early, which is equivalent to increasing the price of the other nine lamps. K would have been among the best had not one lamp broken at the critical point. The best age of all but M are between 300 and 400 hours.

The scale of ordinates in Fig. 3 is much larger than that in Fig. 2, and the minimum point is therefore much more marked. The offsets in curve K and L are due to breakages among the 10 lamps of which these results are the mean. Curve M is dotted merely to distinguish it from those which it crosses at a number of places.

In addition to these curves attention is called to those shown in "L'Industrie Electrique," Nov. 25, 1892, page 510, or in The Electrical World, Dec. 24, 1892, page 404, deduced by Mr. O'Keenan, for foreign lamps, in which the best age is less uniform and somewhat earlier.

Whatever other deductions may be made from this investigation, the most important is that lamps might to advantage be forced much higher than is customary, a the expense of their life. This, though it requires more frequent renewals, will be a gain to the consumer as well as to the central stations; the former will get better and cheaper light, while the latter will be able to increase their output in lights, or run the same number of lights at less loss in the mains, or, what is equivalent, run the same number of lamps on considerably smaller mains. How far the lamps may be forced before the other extreme is reached is a question to be determined when we have the data for such new lamps.

In conclusion, I desire to state that while some of the results obtained from the present investigation are somewhat striking, it must not be forgotten that we have been considering the cost of a candle power of light; as it is far more difficult to notice slight differences in the light than

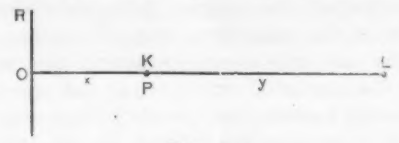


FIG. 1.

it is to notice the bills for lamp renewals, it would not be wise to adhere too strictly to what theory tells us. In practice, therefore, lamps need not be renewed as early as these deductions point out; at the same time, however, these results clearly show that it is absurd to keep lamps running too long, and that the life of our present lamps is more than sufficiently good. Perhaps the best practical rule for renewing lamps is to run them until the diminution in candle power becomes noticeable; after that point is reached, we may rest assured that it is economical to throw them away. It might be argued that the original data is of too crude a form to admit of making deductions involving small differences. The differences, however, are not slight, but very apparent, and, I presume, much greater than any possible inaccuracies in the original measurements. Furthermore, they show the existence of a uniform law. This paper should be considered more as an investigation of the subject, and not as one claiming to show that present practice is radically wrong. I merely wished to prove conclusively the well known fact that it is absurd to run lamps too long. By far the most important conclusion is that it would be far better to force lamps at the expense of their life than to run them at the present efficiency.

The Diffusion of Light.*

BY W. E. SUMPNER.

Before describing the experiments by means of which the reflecting qualities of various substances were measured, it may be well to give an exact meaning to certain terms which are often used in a somewhat vague way. By the *illumination* of a surface is meant the quantity of light incident on it per unit area of the surface. The *reflecting power* of a diffusing surface is the ratio of the amount of light reflected by it to the total amount of light incident upon it. The *candle power* of a source of light in a particular direction is the intensity with which it radiates light in that direction, and in most cases varies with the path considered. The intensity of the light given off by a standard candle in the horizontal direction is taken as the unit of candle power, and the illumination due to the horizontal rays of a candle at the distance of one foot may be taken as the unit illumination, and called a *candle foot*. The illumination due to

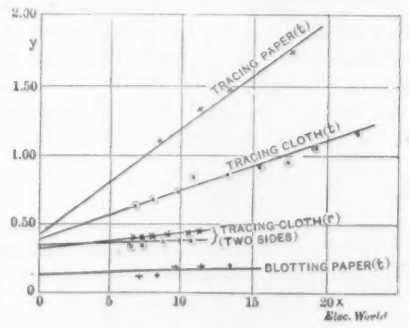


FIG. 2.

a source of K candle power at a distance of F feet is K ÷ F² candle feet. The *quantity of light* received by an area of A square feet placed perpendicular to the rays of light, and at a distance of F feet from the source of K candle power, is equal to the area multiplied by the illumination, and is therefore K × A ÷ F² units of light. The ratio A ÷ F is called the solid angle subtended by the area A at the light, so that the quantity of light given out by a lamp of K candle power within a solid angle Ω is KΩ. If the lamp radiates light equally well in all directions, so that its candle power is independent of the direction of the rays, the total quantity of light given out is 4 π K, since the solid angle subtended by a sphere at its centre is 4 π, or 12.6. A light of 1 c. p. thus gives out 12.6 units of light, a fact which has been called "absurd" by some writers, who seem unable to distinguish between the ideas represented by the words "candle power" and "quantity of light." There is, however, nothing more absurd about this tat ement than about the equivalent one that the area of a sphere of radius one foot is 4 π square feet, and not simply one square foot. It might be for some reasons convenient to take as the unit quantity of light the total light given out by a source of 1 c. p. But the simplification so introduced would be apparent and not real; and it would be as undesirable to adopt the definition for the unit amount of light as it would be to use the area of a sphere of unit radius as the unit of area.

Besides candle power, illumination and quantity of light, there is one other term which it is necessary to use when considering the subject of diffusion. This term is the word *brightness*. A luminous surface may be said to have a brightness of one candle per square foot, when an area of one square foot of the surface acts like a lamp of 1 c. p. in the direction normal to the surface. If B is the brightness of a surface of area A, the illumination produced by it at a distance, F, in the direction perpendicular to the surface is B A ÷ F² or BΩ where Ω the solid angle subtended by the area at the point at which the illumination is measured. The candle power of a bright surface in directions inclined to the normal is found to vary as the cosine of the inclination of the ray to the normal, and from this fact it can be shown mathematically that the total quantity of light given off per unit area of a surface of brightness B is equal to π B.

It is this fact that renders it possible to measure the reflecting power of a diffusing surface. No instruments exist by means of which light can be measured as a quantity. But candle power can be measured with a photometer, and the brightness, B, of a diffusing surface can be found by dividing its candle power, measured in the normal direction, by the area of the surface. When B is once obtained, the total light reflected by the surface can be calculated from the formula π B A, where A is the area of the surface. To connect this with the reflecting power, r, of the surface we have the equation π B = r I, where I is the calculated illumination of the surface. This equation must hold, because I is by definition the amount of light incident upon the surface per unit area, and consequently r I must be the amount reflected; that is, π B.

It is of some interest to compare the values of B for white paper under various conditions such as frequently occur. Referring to some measurements made by Prof. L. Weber (Lond. *Electrician*, Vol. XXV., p. 404), we find that when exposed to a summer sky the brightness of white paper is over 30 c.p. per square inch, or B = 4,300 c. p. per square foot. When illuminated by ordinary diffused daylight within a room, the value of B is much less, and may be obtained from the relation π B = r I. The value of I for ordinary daylight within interiors probably does not much exceed 20 candle feet, also r for white paper may be taken as 0.8. It follows that B is only 16 ÷ π, or 5.1 candles per square foot. At night-time a room is considered well lit if the illumination I is as much as 1 candle foot, and in this case B is only 0.25. The illumination due to moonlight is about 0.025, and it follows that a piece of white paper exposed to the rays of the moon has a brightness of only 0.006 candle per square foot. The ratio of 4,300 to 0.006 is over 700,000, yet this large number represents the relative brightness of a piece of white paper when successively exposed to the rays of the sun and moon What has been stated with reference to white paper applies, of course, equally to all diffusing surfaces, the brightness being simply proportional to the reflective power of the surface Since this reflective power for most substances ranges between 20 and 80 per cent., it follows that the brightness of the walls of rooms (in candles per square foot) varies, as a rule, from one to five during the day, and during the night from 0.05 to 0.25. Even the blackest surfaces we know of are capable of reflecting a great deal of light. It appears from the results already referred to that black velvet, which is probably the worst of reflectors, is capable of shining with a brightness of over 6 c. p. per square foot when exposed to the summer sky at noon, and therefore can give off as much light as the same area of white paper when illuminated with diffused daylight such as ordinarily occurs within interiors.

The dazzling effect of a large white surface is well known, and Alpine climbers and others who traverse fields of ice or snow always protect their eyes from snow blindness by using dark spectacles. The necessity for taking such precautions becomes evident on calculating the amount of light received by the eye from the snowfield. If B is the brightness of the field, and Ω the solid angle it subtends at the eye, the illumination at the surface of the eye due to the snowfield is B Ω and it will frequently happen that Ω is as much as a half a hemisphere, or π. But π B = r I where r is the reflecting power of the snow, and I is the illumination of the snow due to the sun's rays. The value of r for fresh snow is certainly over 80 per cent., and is more probably 90 per cent.; so that the illumination at the surface of the eye due to the snow is practically the same as if the eye were directed straight at the sun.

MEASUREMENTS OF REFLECTING POWER.

The following is a convenient method of measuring the reflective power of a diffusing surface, and was the one adopted in making most of the measurements recorded in Table I.* The surface, whose reflecting power was required, was attached to a large screen of black velvet, O R, placed at one end, O, of a three-metre photometer bench, O L (see Fig. 1), so as to be perpendicular to its length. Two lights were used, one being a Methven two-candle gas standard, placed at L, and the other a glow lamp, K, of

* Just before going to press I have received permission from the makers to state that the lamp marked M is the "Pennsylvania" lamp.

* From the Lond. *Electrician*. For an abstract of the first portion of this paper see THE ELECTRICAL WORLD, March 4, p. 160, in the "Digest."

* See THE ELECTRICAL WORLD, March 4, p. 160.

about 20 c. p., placed at P. This second light was placed on the same slider as a Lummer-Brodhun photometer,* and just behind it. The photometer slider was moved along the bench till the illumination due to reflection from the surface O R was equalized by that caused by the direct rays of the Methven standard at L. In some cases both O P and O L were varied to get the adjustment.

If the distances O P and P L be equal to x and y respectively; if K and L respectively denote the candle powers of the glow lamp and the Methven standard; and, finally, if A be the area of the diffusing surface on the screen O R, it can be shown that the reflecting power r is given by the equation

$$r = \frac{L\,x^2}{K\,y^2}\left\{\frac{\pi\,x^2}{A} + 1.75\right\}.$$

The area A should not be much longer in one direction than in the other. It should preferably be round, or nearly square, with its centre placed at O on the line of centres of the bench.

The above formula is only true for surfaces which are purely diffusive. Some surfaces, such, for instance, as white enameled iron, shine under the action of light, and reflect to some extent in accordance with the law of regular reflection. With such surfaces the value of r calculated from the above formula is found to vary with the value of x, and is too high. If r_1 is the proportion of the incident light which is diffused, and r_2 the proportion which is reflected according to the regular law of reflection, it can be shown that

$$\frac{L\,x^2}{K\,y^2}\left\{\frac{\pi\,x^2}{A} + 1.75\right\} = r_1 + 4\left\{\frac{\pi\,x^2}{A} + 1.75\right\}r_2.$$

The true reflecting power r is given by the equation $r = r_1 + r_2$; and in order to obtain it, it is necessary to make experiments with various values of x, and to plot from the results a curve having for abscissæ the values of

$$X = \frac{\pi\,x^2}{A} + 1.75,$$

and for ordinates the values of

$$Y = \frac{L\,x^2}{K\,y_1^2}\left\{\frac{\pi\,x^2}{A} + 1.75\right\}.$$

The equation between X and Y is that of a straight line:

$$Y = r_1 + r_2\,X + 4,$$

from which the values of r_1 and r_2 can be obtained. The value of $r = r_1 + r_2$ can be found by simply observing the value of Y, for which X = 4.

The observations referring to the reflecting power of tracing cloth, and plotted in Fig. 2, form an example of this method, and the observed values of the different quantities are given in Table II. This substance is the ordinary material used in drawing offices. It shines more on one side than on the other, but each side reflects a certain amount of light in accordance with the law of regular reflection. The values of x and y given in the table were he quantities actually observed. The values of X and $Y_{obs.}$ are calculated from x and y by means of the formulæ given above, and values of $Y_{calc.}$ are those given by the straight line $Y_{calc.} = 30.9 + 4.8\,X + 4$, which most nearly goes through all the observed points.

TABLE II.—REFLECTING POWER OF TRACING CLOTH (SHINY SIDE)

A = 1,300. K = 12. L = 2. r = 35.7. $Y_{calc.} = 30.9 + 4.8\,X + 4$.

x.....	50	55	62.3	59.8	47.5	44.5
y.....	90	104.4	127.7	120.2	82.5	75.5
X.....	7.82	9.10	11.13	10.45	7.22	6.5
$Y_{obs.}$.....	40.4	41.8	44.1	43.2	39.6	38.6
$Y_{calc.}$.....	40.3	41.8	44.2	43.4	39.6	38.7

The four substances mentioned at the head of Table I. are common specimens of white diffusers. The first two—viz., blotting paper and cartridge paper—reflect a great deal of light and transmit very little. The two latter—tracing cloth and tracing paper—on the other hand, transmit a large portion of the light incident upon them, and reflect comparatively little. These surfaces were accordingly selected for the most careful measurements, and the results of the reflection tests are summarized in Table III.

TABLE III.—PERCENTAGE REFLECTIVE POWER.

	Diffused r_1.	Regular. r_2.	Total r.
Blotting paper	82	0	82
Cartridge paper	80	0	80
Tracing cloth (shiny side)	30.9	4.3	35.7
" " (rough side)	31.6	2.7	34.3
Tracing paper	19.8	2.7	22

(To be Continued.)

Electrical Oscillations of High Frequency.—IV.†

BY ERVIN S. FERRY.

A resonator with extensible sides and fitted with an electrometer, as used in the Physical Laboratory of Cornell University, was shown in Fig. 7 in the previous section of this article. (See The Electrical World of March 4, p. 156.) In Fig. 10 the same is shown as mounted with the exciter and arranged for observation.

PROPAGATION IN WIRES.

The phenomena of reflection and interference of electrical oscillations can be observed in metallic wires with even greater ease than in the air. For this purpose Hertz placed within a few centimetres of the plates of the exciter and parallel to them two other plates, of the same shape and size, connected to two long wires whose direction was normal to the plane of the exciter. These wires were suspended horizontally, and were but a few centimetres apart. From the arrangement of the apparatus it would be expected that the secondary plates would receive the radiated electric energy and transmit it in waves to the end of the wires, when it would be reflected back. This reflected wave would naturally interfere at points with the direct wave, and so produce nodes analogous to them in a vibrating stretched cord. The position of these nodes can be easily determined in several ways. The method Hertz used was to place under one of the suspended wires a circular resonator, having the air gap directed toward the wire. The plane of the resonator was vertical and parallel to the wires. In this position there would be no action from the exciter due to propagation through the air, but only that due to the wave in the wire. In this manner he located the nodes and loops on each wire with accuracy. He found that if the wire be cut at a node, the oscillation was not affected in the remainder of the wire. With wires of different material, diameter and resistance no difference was discovered with regard to the length of the wave transmitted.

Birkeland* located the nodes by means of a telephone. One end of the telephone was grounded and the other placed at a fraction of a millimetre's distance from the wire. When a spark passed the telephone would sound and the location of the node was determined by the silence in the telephone.

Lecher† used for an indicator a Geissler tube. It was laid across the four ends of the two wires, and a short conductor connecting the two wires was moved back and forth. At certain positions of this bridge the Geissler tube would be lighted up, and at others remain dark, thus locating the loops and nodes. This is analogous in action to moving the bridge of a sonometer.

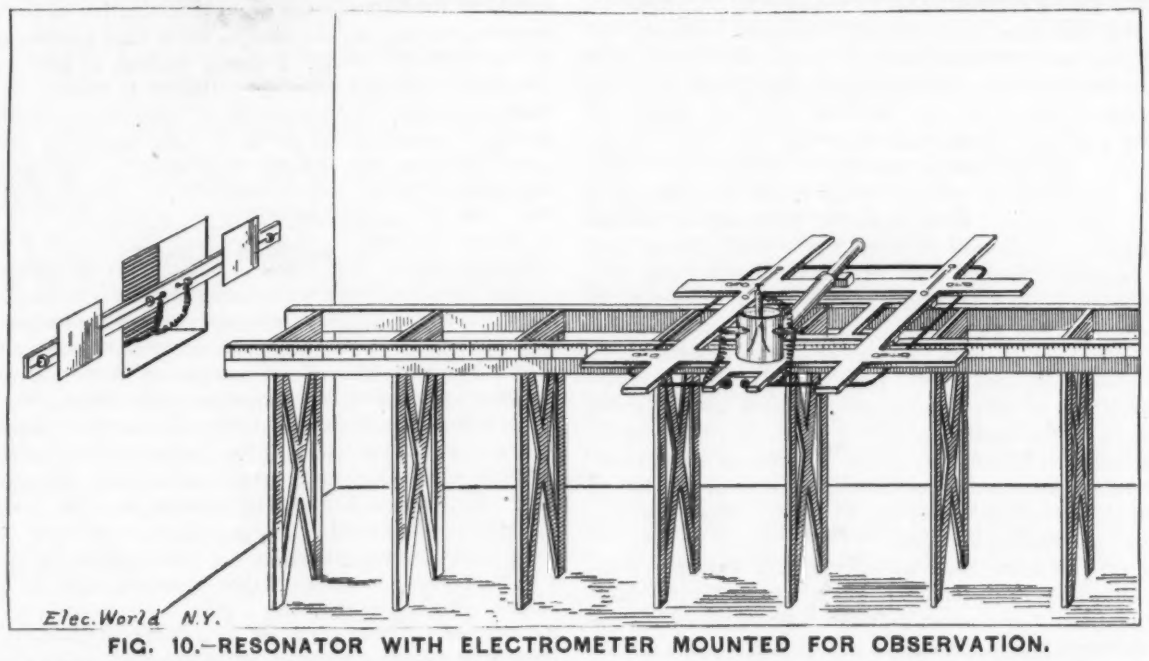


FIG. 10.—RESONATOR WITH ELECTROMETER MOUNTED FOR OBSERVATION.

VELOCITY OF PROPAGATION OF ELECTRICAL OSCILLATIONS.

It will be remembered that in the second section of this article, in determining the period of oscillation emitted by the exciter, the assumption was made that the velocity of propagation of electrical oscillations is the same as light. We are now in a position to test the validity of this assumption. From the original equation

$$T = 2\,\pi\,\sqrt{C'\,L},$$

in which C' and L represent the capacity and self-induction, respectively, of the exciter in electromagnetic measure, we can compute approximately the period of oscillation from the dimensions of the exciter, or we can measure experimentally C' and L. But we also know that

$$\lambda = V\,T$$

when λ is the wave length of the oscillation and V the speed of propagation λ can be measured in a standing wave produced by reflection, by means of a resonator that is in harmony with the exciter. Thus V, the velocity of propagation, can be determined.

In this manner Blondlot‡ has determined the speed of propagation of electromagnetic waves in wires for a wide range of wave lengths to be constant and equal to 297,600 kilometres per second. Messrs. Sarrasin and de la Rive§ have found the rate of propagation in air and wires to be the same, which is in accord with Maxwell's theory; although earlier, Hertz, by a different method, found the ratio to be as seven to four. It is thus seen that it is safe to assume the velocity of electrical waves to be the same as light.

REFLECTION.

The reflection from plane conducting surfaces has already been considered for the case when the direction of the incident and reflected ray are normal to the surface. Early in his investigation Hertz used parabolic reflectors to intensify the effect of the radiation. The reflector was made by binding a sheet of zinc two metres square around a parabolic template, so as to form a cylindrical parabolic mirror two metres high and 1.2 metres aperture. In the focal line was placed a linear exciter formed of two brass tubes, each 13 centimetres long and 3 centimetres in diameter, having a spark gap bounded by spherical surfaces of 2 centimetres radius. The wires connecting the exciter to the induction coil passed through small holes directly back of the exciter. The receiver was a similar parabolic reflector, having in its focal line a linear resonator. For convenience of observation the spark gap of the resonator was back of the reflector and connected by wires passing through holes in the zinc to the rods forming the resonator. With this pair of mirrors, waves that by the previously described methods could not be distinguished for a greater distance than 2 metres, could be traced as far as 16 metres.

If, now, the two mirrors be placed side by side with their axes directed to a common point, and a plane reflector be placed at this intersection of the axes, so that the axes make equal angles with the reflector, vigorous sparking will occur in the resonator air gap.

If the plane reflector be turned as much as 10 degrees, the sparking will entirely cease. This shows that the angles of incidence and reflection are equal. If the plane reflector be removed, or if a conducting screen be interposed between either of the parabolic mirrors and the plane reflector, the sparking in the resonator will immediately cease. This shows that the action is really transmitted from the exciter to the plane reflector and from that to the resonator. By means of a circular resonator, the wave surface of the ray can be determined before and after reflection. The wave surface is found to be normal to the direction of propagation, both before and after reflection, and, therefore, the ray suffers change of sign at reflection. Conducting surfaces are good reflectors, and non-conducting walls will also reflect when the exciter is normal to plane of reflection, and the thickness is such that destructive interference does not occur between the rays reflected from the two surfaces.

REFRACTION.

On account of the great length of electrical oscillations, any apparatus to test the bending of the ray in passing from air to another medium must be of heroic dimensions. Mr. Hertz met the difficulty by constructing a huge 1,200-pound prism of hard pitch, 1.5 metres high and an equilateral triangular base of 1.2 metres. The exciter mirror was set up at a distance of 2.6 metres from the prism and directed to its centre of gravity. The region back of the prism was then explored with the resonator mirror by moving it in the circumference of a circle having the centre of gravity of the prism for a centre. It was found that in the direction of the incident ray there was no effect back of the prism, but when the resonator had been moved 11 degrees from this position away from the refracting angle, sparking occurred in the resonator. This sparking increased in intensity up to about 22 degrees, and then diminished as the resonator was still further displaced. This sparking could be observed when the resonator was five metres away from the prism. It was proved that the effect really went through the prism, by placing conducting screens in the path of the ray, in which case no effect occurred in the resonator. From the measurement of the refracting angle of the prism and observed deviation of the ray, Hertz found the refraction index of the pitch for electrical oscillations to be 1.69.* The refraction index of pitch for light is about 1.6. The difference between these two values is easily accounted for by the uncertainty of observation and impurity of the mass.

Drs. Lodge and Howard† have extended this experi-

* For a description of this photometer see *The Electrician*, vol. xxvi., p. 620.
† For parts I., II. and III. of this article see The Electrical World of Feb. 4, 11 and March 4, 1893.

* Ann. du Physik und Chemie, 47, p. 583 (Nov., 1892).
† Ann. du Physik und Chemie, Nov. 12, 1890, p. 550.
‡ Comptes Rendus, 113, p. 628.
§ Comptes Rendus, 112, p. 658.

* Hertz, p. 184, also Phil. Mag., 27, p. 289 (1889). Phil. Mag., 28, p. 48.

ment of Hertz by using lenses made of pitch. The lenses were hyperbolic cylinders 85 centimetres high and 90 centimetres broad, and each weighed over 300 pounds. These lenses concentrated the rays strongly at their focal lines, and so the parabolic mirrors of Hertz were unnecessary to increase the action of the exciter and resonator. The exciter was designed to give oscillations of one metre wave length, and was placed at the focal line of one lens. The resonator was linear, and placed at the focal line of the other lens. With this apparatus all the experiments were repeated that Hertz performed with his parabolic reflectors. The position of the focal line as determined by experiment was very close to the place computed for it on the assumption that refraction of electrical waves obeys the same laws as the refraction of light.

POLARIZATION.

The experiments described in reflection by concave mirrors suggest that the ray is polarized by reflection. This is definitely proven by the later experiments of Hertz. If the exciter mirror be rotated around the ray as an axis, the sparking in the resonator will gradually decrease until the exciter and resonator mirrors are at right angles to each other, when there will be no effect in the resonator. Thence the action of the two mirrors is the same as the polarizer and analyzer of a reflecting polarizing apparatus.

Mr. Hertz next constructed a frame two metres square and strung it on wires three centimetres apart and parallel to each other. If this be placed between the parabolic mirrors when their focal lines are parallel—in such a manner that the wires are at right angles to the plane of the focal lines—the screen will exert no effect on the disturbance in the resonator; but if the screen be rotated till the wires are parallel to the plane of the focal lines, the sparking in the resonator will entirely cease. The wire grating thus acts like the tourmaline plate to a polarized ray of light. When, however, the focal lines of the mirrors are at right angles to each other, if the grating be placed with the wires parallel to the focal line of either mirror, no sparking will occur; but if the grating be inclined 45 degrees to either focal line, sparking will occur at the resonator. This effect is similar to the brightening of the dark field of crossed Nicols prisms when a tourmaline plate is placed between them.

Tronton,* of Dublin, has found that "the electromagnetic component is not reflected at the polarizing angle from the surface of a bad conductor when the electric force is parallel to the plane of incidence, but reflection occurs at all angles when the electric force is perpendicular to the plane of incidence." This proves that the electromagnetic component is in the plane of polarization and the electrostatic is normal to it.

CONCLUSION.

From this description of the experiments recently performed in electrical oscillations, it will be seen that the conclusion that light and electrical oscillations are identical is very strongly substantiated. The principal parts in which they practically agree are, the velocity, rectilinear propagation, laws of reflection, interference, refraction, polarization and absorption by material substances. In fact the sole certain difference appears to be the wave length. There is difficulty in producing continuous electrical oscillations of less than a foot in length, while light is about the hundred thousandth part of an inch. The only difference between them is that our eye will appreciate the short ones, but is not affected by the long ones. The great question for electrical engineers is to produce these very short wave lengths directly. Hertz, by the induction coil and condenser, and Tesla with a specially designed multipolar dynamo, have produced similar waves, which will set molecules in a rarefied atmosphere into such rapid vibration as to produce light. But the great question has advanced only one step. Probably neither of these methods will furnish more than a suggestion to the real solution. A simple computation will show that by the Hertz method, in order to produce directly vibrations capable of affecting the retina, the condenser would be of nearly molecular size; on the other hand, by the Tesla method, the dynamo necessary would be a mechanical impossibility. However, the outlook is encouraging, and any work done along these lines cannot be otherwise than of benefit to science and to practical engineering.

In the domain of wireless telegraphy this subject is of prime importance. Much has already been done in this direction, and much more will undoubtedly be done by the aid of electrical oscillations of high power and frequency. The Edison method of telegraphing from moving trains is probably the best known practical application of electrical oscillations in air to commercial practice. Betts' method of telegraphing between ships at sea is another well known application, and depends upon the transmissibility of electrical oscillations through water. Although these methods are far from perfect, the end seems not distant, and we can confidently expect that in the near future we will be able to telegraph on land and sea without wires with great ease by means of electrical oscillations of high power and frequency.

* Nature 39, p. 391.

Electricity at the World's Fair.

RESIGNATION OF MR. FREDERICK SARGENT.

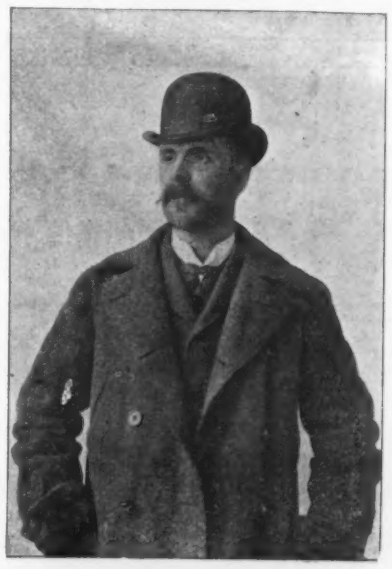
Quite a startling sensation was created about the World's Fair Grounds last week, when it was made public that the Council of Administration had accepted the resignation of Mr. Frederick Sargent, who has been connected with the Exposition for over eighteen months, first as electrical engineer, then as mechanical and electrical engineer and now under a recent reorganization the general manager Mechanical and Electrical departments.

It was rumored some time ago, when a difficulty arose on the matter of certain boiler contracts, that Mr. Sargent would tender to the council his resignation; but at present it was generally considered that the affair had been amicably settled, and that under the new organization of the departments a permanent adjustment had taken place. So that the news came with all the more surprise.

FRED H. SARGENT.

The cause of Mr. Sargent's resignation dates from the matter of boiler contracts above mentioned. When in November last it was found necessary to obtain more boilers than had originally been contracted for, Mr. Sargent, after considerable negotiations, allotted a vacant space of 75 feet at the west end of the boiler house to the Babcock & Wilcox company, who already had the boilers adjacent. Shortly after this the Stirling company secured the annulling of Mr. Sargent's allotment by the Council of Administration, and their own appointment to the space. The Babcock & Wilcox company secured an injunction, and the matter was decided by the courts in favor of the Stirling company.

Through this affair and on account of complications in other matters, Mr. Sargent felt that he was not receiving from the council the vigorous and prompt support which it seemed to him the exigencies of his work demanded, and that without such support he would be unable to



R. H. PIERCE.

carry on the work to a successful termination.

By the Council of Administration Mr. Sargent is blamed for assuming responsibilities neither necessary nor justifiable, and recently for a lack of organized execution which has caused the Mechanical and Electrical departments to be much behind their appointed times.

Mr. Sargent's work now falls wholly on Mr. R. H. Pierce, the electrical engineer, and Mr. C. F. Foster, the recently appointed mechanical engineer.

THE ARC LIGHTING SYSTEM FOR THE MANUFACTURES BUILDING AT THE EXPOSITION.

The problem of lighting the great hall of the Manufactures Building at the Exposition was one of very unusual conditions for the electrical engineer. It was not especially the enormous size of the hall alone, but the fact that its roof arched to a height of over 200 feet added somewhat to make the problem more complex.

Of course it was always possible to erect posts on the floor and adopt the same method as is done in out of door work. But there were many objections to placing posts on the floor, and in a building of such grand and massive proportions the interested visitor would expect to see a system of illumination of unusual brilliancy and of striking effect. And so after much discussion and presentation before various committees and authoritative individuals, the scheme of having five immense coronas suspended from the roof trusses was settled upon and approved.

The lighting of that portion of the building outside of the main hall was a problem of only an ordinary arrangement of lights suspended from a comparatively low ceiling.

The general design and arrangement of the Manufactures Building are now very generally understood. The building is about 1,680 feet long by 800 feet wide, and is comprised of the great central hall, 1,240 by 380 feet, surrounded by an area about 200 feet wide and which is two stories in height, save that the second or gallery floor is cut by numerous large openings to admit daylight to the lower floor. The main hall is spanned by a series of steel strusses of a nearly semi-circular form, having a height in the clear at the highest point of about 200 feet.

The five coronas which are to illumine this grand room at night are placed in a line down the centre of the hall and are hung from the trusses above so that their lights hang 160 feet above the floor. The central corona, which is directly over the clock tower that is to form the central feature of the great hall, is larger than the others, and contains 102 2,000-c. p. arc lights. Each of the others contains 76 lights. Each corona is composed of two circles of lights, the central corona being about 85 feet in outside diameter and the others 70 feet. The outer ring of each corona is not exactly circular, but is made up of canvas, bound slightly toward the centre so as to give somewhat of a star-shaped appearance. The large corona has seventeen points and the others thirteen.

For the support of the coronas a circular platform 3 feet wide and 60 feet diameter for the smaller coronas is hung by wire ropes from the trusses and rafters of the roof. The platform is rigidly constructed of angle irons and heavy plank flooring, and is railed with angle irons and cross braced. The circles of lights of the coronas are arranged one just inside and one outside of the platform, and are set so as to hang just below the level of the platform. The lights of the two rings are as far as possible arranged in pairs and connected by a wire rope running over pulleys above the platform, and so arranged that in raising the lights to the platform for trimming the weight of one balances the other. Access to the coronas is had by means of small shafts which run from the trusses above to the platforms. The wires are also run within this shaft. It will be necessary for the lamp trimmer to climb each day the fire ladders which are laid up the immense trusses and then down the 60-foot shaft in order to reach his lamps.

In addition to the coronas the main hall of the building is provided with a series of lights set all around the outer edge of the hall about 45 feet apart. These are so placed to counteract any shadows which might otherwise be thrown by the coronas at these outer points.

The remainder of the main floor and the gallery of the building are illuminated by lights arranged down the aisles and placed about 40 feet apart. In the loggias around the outside of the building the lights are placed from 50 to 75 feet apart. There is a total of 414 lights in the coronas and 394 on the main floor, exclusive of the coronas and loggia lights. There are 70 lights in the loggias and there will be about 320 lights in the gallery, making a total of nearly 1,200 lights in the entire building.

The lights throughout the building are arranged in circuits of about fifty lights each, each circuit returning to one of the switchboards in the power plant in Machinery Hall. A certain number of lights scattered throughout the building are designated for "patrol lights," intended to run all night, and these are placed in separate circuits. Of these patrol lights, there are 24 in the coronas and 40 others on the main floor, and about that number in the gallery.

Besides the arc lights in the Manufactures Building, there will be a certain number of incandescent lights in offices, restaurants and toilet rooms, but this is inconsiderable, and there will be also the exterior illumination of the building by the outlining of its cornices with incandescent lights.

The design of the system of illumination for the Manufactures Building is due chiefly to the work of Mr. Sargent, Mr. Pierce and Mr. Luther Stieringer, the consulting electrical engineer.

INSTALLATION OF EXHIBITS.

The outlook for the completion of the power plant on the opening, May 1, is now very encouraging, and, while a considerable amount of work will have to be done after that date, it is fully expected by the authorities that by far the major part of the plant and all the more important engines will be in operation before May 1. Several engines are now on their foundations, and bills of lading are coming in daily for the others that are due.

A large amount of the piping has been ordered, and the place is becoming crowded with fittings, valves and cut lengths of pipe which will at once be put together. Most of the piping is furnished by the Crane Company, of Chicago, though a fair proportion of the steam pipe work has gone to J. B. Clow & Son. All the valves and fittings of the larger sizes for the steam connections are extry heavy and, notwithstanding the fact that most of them have to be specially made, they are being turned out with remarkable rapidity.

Several of the huge castings for the bases and field magnets of the Westinghouse dynamos have been received during the past week. Some of the "nine-foot" pulleys have been on the ground for some time. One of the armatures was switched into the building a day or two ago, and others are on the way. The work of erecting Westinghouse machines will be begun at once.

The arc light machines are all in the building and many are in place. Rigid orders have been issued by Director of Works Burnham that the old "temporary plant," which has done good service ever since October, 1891, must be removed by March 15. To take the place of this a portion of the permanent plant will be in operation before that time; three of the Ball & Wood engines and Brush dynamos for the arc light, the two 4,000-light Westinghouse dynamos for incandescent, one of the Woodbury engines, with its Mather generators, and the McEwen engine, with C. & C. generators, for power.

Work in the electrical department has been somewhat delayed by a strike of the wiremen. The men demanded more pay and insisted that more could be obtained on work in the city. This was probably due to an unusual demand for wiremen on some of the new large buildings in town. About seventy men out of between 300 and 400 went out, however, and the only work which has suffered is the temporary work, the special connections of all kinds for lighting and power which are continually required about the grounds. The work for the permanent installation has proceeded with scarcely an interruption, however.

In order to overcome certain difficulties of classification which have presented themselves both to the officials and exhibitors, the following order has been issued, signed by J. P. Barrett, chief of the Department of Electricity:

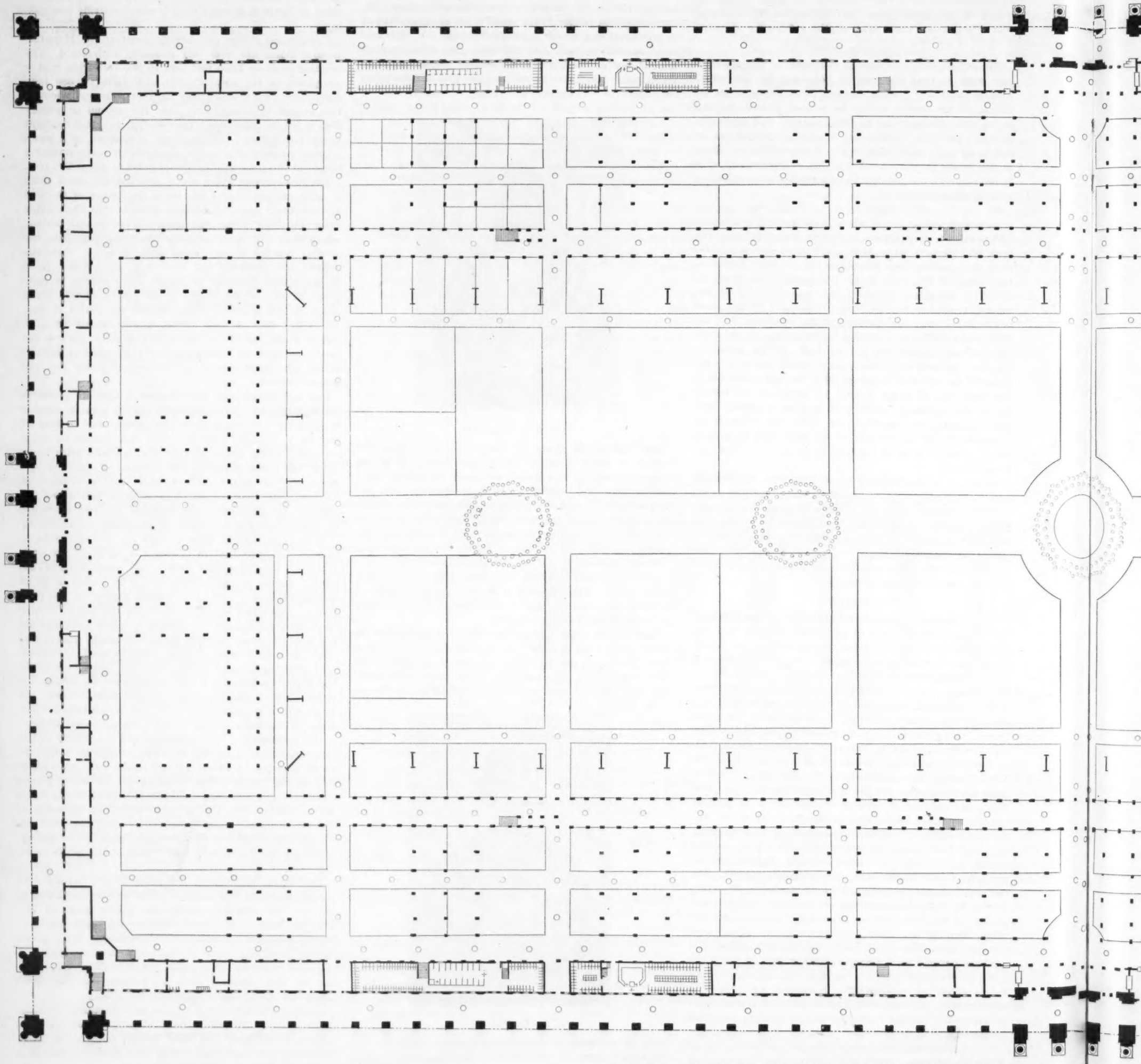
"By special arrangement with the Director-General, this department has the privilege to add to the classification originally adopted by the World's Columbian Commission, and it has been determined that this addition shall take the form of a new group. Classes have been added under this group sufficient to cover a variety of apparatus, either properly electrical or auxiliary to other exhibits essentially electrical in character. A number of our exhibitors have found difficulty in properly classifying some of their apparatus, and it is hoped that this new group has been made general enough to cover everything not heretofore classified. Those exhibitors who have found difficulty in properly classifying their exhibits will confer a favor on the department by sending to us immediately a list of those things in their exhibits which can be better classified under this new group than in the old classification.

"Early attention to this matter will make it possible for the department to give proper credit to exhibitors in the first edition of the official catalogue."

GROUP 138 "A."

Class A.—Construction tools, repairing tools, apparatus used in electrical construction.

Class B.—Apparatus for transmission of power to elec-



ARRANGEMENT OF ARC LIGHTS IN THE MANUFACTURES AND LIBERAL ARTS

trical generators (steam, compressed air, turbine, oil, friction, gearing, belting, etc., etc.).

Class C.—Processes of electro-engraving.

Class D.—Carbon and its application.

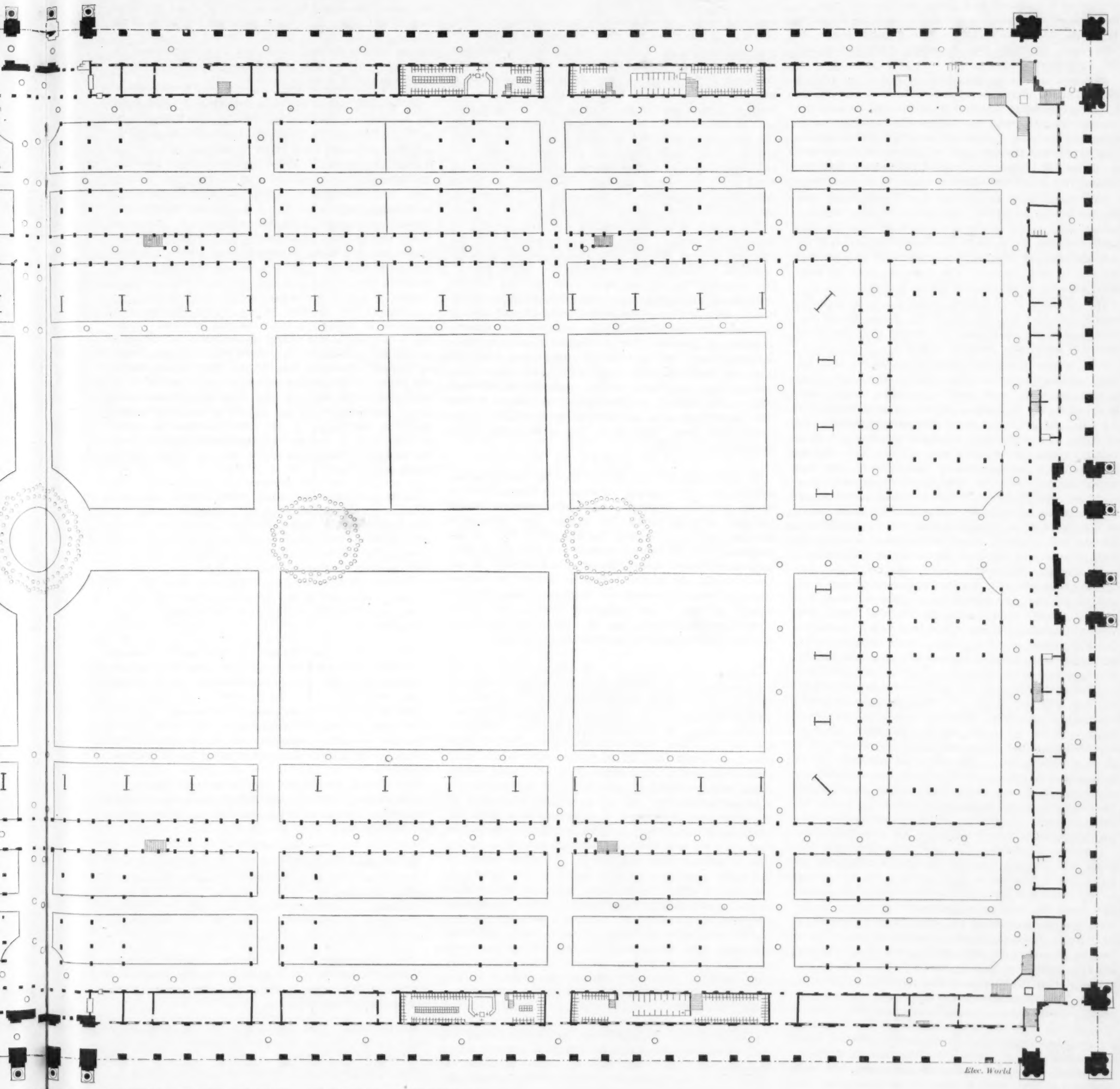
Class G.—Metals and their application in the construction of electrical apparatus.

Class H.—The "Kinetograph."

Class J.—Direct coupled engine dynamos.

Class K.—Electric lubricators.

Class L.—Application of electricity in testing and ageing liquors.



D LIBERAL ARTS BUILDING AT THE WORLD'S COLUMBIAN EXPOSITION.

Class M.—Electric tanning.

The following order, signed by Geo. R. Davis, Director-General, and addressed to all department chiefs, has also been promulgated:

"Arrangements have been made to admit free to the Exposition exhibitors and others having business with the Director-General, offices of the chiefs of departments and other Exposition offices. Such persons should be directed to apply at Gate A, between Sixty-second and Sixty-third streets, where the guards have been instructed to extend proper courtesy to persons entitled to enter under the above conditions."

Dr. Enward Hopkinson on Electrical Railways.

The paper read by Dr. Edward Hopkinson before the Institution of Civil Engineers and reproduced in abstract in "The Electrical Engineer" (London) possesses interest not only in coming from such an authority, but as giving data upon a subject which is coming more and more into prominence, and upon which reliable information is so eagerly sought, and has in the past always been so difficult to obtain.

After reference to the recent progress made in the United Kingdom in the application of electric traction to tramways, and a comparison of this with the work done on the Continent and in the United States, Dr. Hopkinson gave a brief account of the conditions which Messrs. Mather and Platt, of Manchester, were required to meet in their contract for the electrical plant of the City & South London Railway. The leading features of the line were briefly alluded to. The maximum gradients were 1 in 14 with, and 1 in 30 against, the traffic. There were four intermediate stations between the city terminus and that at Stockwell, the trains running at intervals of from three to four minutes. The total length was 3 miles and 270 yards. Full details were given of the generator station. There were eight boilers of Lancashire type set on the Livet principle, with Vicar's automatic stokers, working at 140 pounds pressure per square inch. The generating plant consisted of four open vertical compound engines and four "Edison-Hopkinson" dynamos. The latter were belt-driven, and had an electrical efficiency at full load of 96 per cent., and a commercial efficiency of 93.4 per cent., their weight being 17 tons. They were compound wound, and had a maximum output of 450 amperes at 500 volts, running at about 500 revolutions per minute. In connection with the driving of the generating dynamos, the theory of jockey pulleys on high-speed belts was considered and their use justified.

The feeding conductors employed were of the Fowler-Waring type, the working conductor being of channel steel, laid between the rails and carried on glass insulators fixed to the sleepers. The channel, rolled from a special quality of steel, had a specific resistance as low as 0.0000105 ohm at 24 degrees centigrade. The actual leakage on the entire system, including generating dynamos, feeders and working conductors, was in gen-

eral 0.5 ampere, corresponding with a loss of 0.3 h. p. The return circuit was through the rails, which were uninsulated, and the method of dealing with the conductor at points and crossings was described.

The essential and novel feature in the design of the locomotives was that the armatures of the motors were built directly upon the axles, while the magnets were supported partly upon the axles and partly on the frames; thus, gear of any description was entirely obviated, and the mechanism was reduced to its simplest elements. It was shown that the system of direct driving did not require a greater dead weight upon the line than was usual in ordinary locomotive practice, and that no injurious effects upon the armatures could be traced to vibration. The total weight of each locomotive was 10 tons 7 cwt., the length over the buffers being 14 feet, and the wheel-base 6 feet.

The two motors on each locomotive on the City & South London line were both capable of developing 50 h. p., corresponding with 310 revolutions of the axle per minute. The magnets were of the "Edison-Hopkinson" form, series wound, the armatures being of the Gramme ring type. The tractive force of the locomotives with a current of 10 amperes was 1,180 pounds, and the maximum tractive force 3,000 pounds.

The trains were fitted with the Westinghouse continuous automatic brake. Instead of a pump working continuously on the locomotive, the latter was provided with reservoirs placed under the curved side-plates of the cab, and charged with air at a pressure of 80 pounds at the end of each journey. The reservoirs were of sufficient capacity to provide for about 30 stops.

The efficiency of an electric railway system might be considered under three heads: (1) The production of electrical power; (2) its distribution; (3) the reconversion of electrical power into mechanical power.

With regard to the first head, it was shown that the daily consumption of electrical energy, with eight trains in constant work, was about 3,700 units, which were produced by the combustion of 7.5 pounds of Welsh coal per unit. As in the case of electric lighting stations, the efficiency of production of electrical power was greatly reduced owing to the variations of load. The average load on the generating engines and dynamos was only about one-half their full load, and consequently they could not work under conditions of maximum efficiency. The engines average 230 indicated horse power each, or only one-half of full load; and they consumed 27½ pounds per indicated horse power hour, as compared with 22 pounds at half load, obtained with Willans high-speed engines. The combined efficiency of engine and dynamo is 78 per cent. at full, 70 per cent. at half load, and 65 per cent. at quarter load. They consume 8.04 pounds of North Country coal per Board of Trade unit. With average load the loss in long feeders is 5.7 per cent., and in distributions 3.5 per cent., a total of 9.2 per cent., say 10 per cent., equal to 1½ tons of coal per day, which exactly comes to the interest on $34,000—the actual cost of conductors, which is strictly in accordance with Lord Kelvin's well known principle—that the cost of power absorbed in the conductors should be equal to the charge for interest on the capital invested in them. Thus the cost of distribution was a minimum. The coal burnt is 35 to 40 tons a day. The electrical efficiency of the system over all is 62 per cent., and the average efficiency of locomotive 70 per cent. These results substantiated the estimates of efficiency given in evidence before the Parliamentary Committees on the Central London Railway bill by Sir Benjamin Baker and Dr. John Hopkinson.

The cost of working the railway in successive half years was deduced from the company's half-yearly returns; and it was shown that the total cost of running is 10.2 cents per train mile without wages, as against 12.6 cents, the total guaranteed cost, or less by 20 per cent. than the guarantee, and this though the trains are 30 per cent. heavier. In additional tables the details of cost to December 31, 1892, were given: Train mileage, 214,417; number of passengers, 3,317,602. Cost of generator station working, including renewals and repairs: wages, 2.24 cents; fuel, 4.84 cents; water and gas, 0.56 cent; oil and stores, 0.82 cent; repairs, 0.72 cent; a total of 9.18 cents per train mile, or equal to 3.12 cents per Board of Trade unit. The cost of locomotive working, including repairs, was: generating station, as above, 9.18 cents; wages, 3.96 cents; oil and stores, 0.20 cent; repairs, 0.46 cent; total, 13.80 cents per train mile. The figure 3.12 cents per trade unit will interest central station engineers, as it is the lowest of any generating station, save Bradford, which generates at 2.82 cents per trade unit, but using cheaper coal; at Pall Mall the cost is 4.52 cents. The trains, when normally loaded, weighed 40 tons, and accommodated 100 passengers. Their average speed, including intermediate stoppages, was 11.5 miles per hour, and that of actual running between stations 13.5 miles per hour. The maximum speed attained between stations varied from 20 to 25 miles per hour. The train mileage for the half year ending December 31, 1892, was 214,417. Since the opening of the line two years ago the locomotives had run more than 820,000 miles, and had dealt with a traffic of over 12,000,000 passengers.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO-PHYSICS.

A Curious Phenomenon.—In a lecture by Lord Armstrong on electrical phenomena, he showed some very interesting experiments; in one of these he took two wine glasses filled to the brim with pure water, connecting the two by a cotton thread coiled up in one glass, the other end dipping into the other glass; on applying a very high potential current, like that from a frictional machine, the coiled thread was rapidly drawn out of one glass and deposited in the other, followed for a few seconds by a rope of water suspended between the two glasses. In another experiment he used a glass bulb having a long neck on one side and a short nozzle of .1 inch diameter on the other, through which aperture a cotton thread was passed barely thick enough to fill the aperture; this bulb was placed in a glass cistern, both filled with distilled water, the neck of the bulb being sealed; the whole was placed in a lantern for projection on a screen; on applying a positive current from an induction coil the cotton climbs up into the bulb; by reversing the current it moves out again; a current of water rushed out of the aperture around the thread, and an equal quantity rushed in within the thread carrying the cotton with it. On removing the cotton, these two currents became visible; this takes place even when the cork is removed, but in that case only when the cotton thread also is removed. He also illustrated the so-called dust figures, obtained by passing electric discharges near a plate covered with a fine powder. He used three kinds of dust—calcined magnesia, mixed with lampblack; tripoli powder and pulverized carbon; each giving different effects; the latter is a conductor, while tripoli is not. The experiments are described at some length in the Lond. "Elec. Eng.," Feb. 10, p. 154, or the Lond "Elec. Rev.," Feb. 17, p. 196.

Mr. Boltzmann ("L'Ind. Elec.," Feb. 10) discusses the subject of a phenomenon analogous to Newton's rings which is produced by the passage of electric waves through metallic plates. He states that Maxwell's theories are easily verified for dielectrics, but not for conductors. A ray of light normal to a metallic surface ought to be almost entirely absorbed in a distance of one wave length, but electric waves of several decimetres ought not to be weakened very much by passing through a plate of metal one millimetre thick. Experience teaches on the contrary that thin plates are absolutely opaque. In his paper he investigates this subject.

In some recent experiments by Mr. Birkeland on the measurement of the moving wave, due to electric oscillations in copper wires, the following conditions existed. Two wires, each 30 metres long, were arranged parallel to each other, the distance separating them being 80 centimetres. These wires were connected to square brass plates, 40 centimetres by 40 centimetres, which were placed opposite to other brass plates of similar dimensions, the latter being in connection with the terminals of a powerful induction coil. By measuring the length of the spark passing between the terminals of a spark micrometer, Birkeland was enabled to estimate the potentials along the wire when the induction coil was in operation; in making these estimations, one of the knobs of the spark micrometer was connected to earth through a telephone, while the other was joined up to the wire by means of a sliding contact; and to reduce the statical effects on the telephone to a negligible quantity, the precaution was taken of laying a thread, which had been moistened with dilute sulphuric acid, across the wires near the collector plates. Measurements were made down to 0.0005 milimetres directly, the passage of the sparks being immediately indicated by the telephone.—Lond. "Elec. Rev."

Electric Waves.—Mr. Guillaume, before the French Society of Physics, states that he thought a series of semi-transparent mirrors made, say, of metallic fabric or of white cloths, and arranged parallel to the reflector at equal distances, would, by reflection, give perfectly pure waves, similar to those in Mr. Lippmann's films. The degree of purity of the waves could be shown by comparing them with those of the exciter.

A short description of the experiments of Messrs. Sarasin and De la Rive, regarding electrical waves, mentioned in these columns some weeks ago, will be found in the Lond. "Elec. Eng.," Feb. 10, p. 148.

Electric Wave Energy.—Mr. Bjernkes, in the "Ann. der Phy. u. Chemie," estimated the absorptive powers of iron, nickel, german silver, platinum, copper and brass by the means of an electrometer, for the energy of electric waves; all of them absorb the energy in different degrees. The rate increases with the resistance and with the degree of magnetization. Iron and nickel produce a damping effect, but their magnetization could be reversed one hundred million times a second.

Mr. Baly, before the Physical Society of London, stated that on examining with a spectroscope a vacuum tube containing a small quantity of hydrogen, he noticed that the hydrogen lines were strongly visible in the negative glow, but could not be seen in the body of the tube; this seemed to point to a separation of gases in the tube. He concludes that when an electric current is passed through a rarefied mixture of two gases, one is separated from the other and appears in the negative glow; also that striae are caused by the separation of the two gases and do not occur in a single pure gas or vapor. Prof. Ramsay stated that if indigo were put in a poor conductor, such as distilled water, and then electrolyzed, the blue color concentrates around one pole, while with arsenic sulphide it went to the other pole.

Mr. Bidwell, before the London Institution, stated that his experiments, between the freezing and boiling point of water, showed conclusively that the resistance of selenium increased until about 20 degrees C, after that it diminished until and at 100 degrees C it was very low; the resistance was much lower in the light than in darkness. The resistance of carbon and sulphur diminished by heating, but in a mixture of the two the resistance increased enormously with the temperature, increasing nearly six-fold from 45 degrees to 55 degrees C. He also stated that if a flame be moved along a wire, a current was generated; the earth's magnetism had thus been explained.

Actinism.—Mr. Rigollet, in the "Jour. de Physique." described an apparatus for measuring actinism, consisting of two plates of oxidized copper, immersed in water containing one-thousandth part of either chloride, iodide or bromide of sodium; one of the plates is exposed to the action of light, while the other is not; the E. M. F. generated varies with the color of the light; with iodized plates the intensity of the current is inversely proportional to the square of the distance from the source of light; this is true for the Drummond light, but not for sunlight. The instrument is used in examining the luminosity of the sky.

Radiant Energy.—The Lond. "Elec. Rev." states that Maxwell concluded that a ray of light must exert a certain presure in the direction of its propagation, numerically equal to the energy contained in each unit of its volumes; of this energy one-half is present in the electric and the other half in the electromagnetic form. Bartoli arrived at the same result in a different way. The last method is criticised by Mr. Galitzine in the "Phil. Mag.," in which he deduces the formula for the pressure of light, giving proofs.

The paper of Mr. Bagart on the thermo-electrical phenomena between two electrolytes, mentioned in these columns some time ago, is contained in full in "L'Ind. Elec.," Feb. 10.

Prof. Hale doubts the supposed connection between sun-spots and magnetic disturbances on the earth, stating that sun spots are so numerous that the chances are 9 to 1 that at any instant some are crossing the solar meridian.

In the Lond. "Elec. Eng." Mr. Walker has a third article on the subject "What Is Electricity?" the present section treating of the generation by friction, but gives nothing particularly new.

MAGNETISM.

Mr. Curie's investigations of the magnetic properties, at different temperatures, of a large number of diamagnetic bodies, published in "Comptes Rendus," Jan. 23, is given in abstract in the Lond. "Electrician," Feb. 17. The abstract gives a table of the results for a number of substances, as also a curve for those of bismuth.

Prof. Liversidge investigated the magnetic property of minerals and finds that it is due to the presence of magnetite; he claims to show also that ordinary iron rust is usually magnetic.

In the Lond. "Elec. Eng.," Feb. 10, Mr. Guy, in his serial on the dynamo, discusses the subject of the magnetic circuit. The matter is not new, but it is well written, and is intended for students and amateurs.

"L'Ind. Elec.," Feb. 10, gives data concerning the value of the earth's magnetism in several towns in France, for Jan. 1, 1893.

MEASUREMENTS, INSTRUMENTS, ETC.

Locating Faults in Mains.—The "Elek. Zeitschrift," Jan. 27, reprints in its entirety a very long paper by Dr. Froelich. The article is of a theoretical and mathematical character, and is suited more for students, as a theoretical discussion of the subject. He suggests a large number of methods, giving their theory. With the exception of one of these methods, which we give below, they are not applicable when any part of a system of mains is grounded, and they are, therefore, of little or no use in practice. This article is reprinted in full in the Lond. "Electrician," beginning Feb. 10, p. 412.

The following method is given for locating faults in underground mains on the street and while the main is in use. In Fig. 1, M M is the main, and a and b are two manholes in the street, between which the fault F is supposed to lie; connections are here made to a galvanometer G and to a bridge wire c d; B is a small battery, the other pole of which is connected to earth; this forms a Wheatstone bridge; the sliding contact on c d is moved until no current flows through the galvanometer; the distance from that point to the two ends c d will then be proportional to the distance of F from a and b. Instead of a galvanometer, a telephone may be used, in which case the current from the battery B must be an intermittent one. (When current flows through the mains some of it must flow through the galvanometer; it is therefore presumed that this constant deflection is considered to be the zero point.)

(As this method requires two wires to be connected to each manhole, we suggest the method shown in Fig. 2, which is very much simpler. The battery B is replaced by a galvanometer and the other galvanometer connection is omitted; the rest of the measurement is made as before. The current operating the bridge is that flowing through the main. The method suggested by Dr. Froelich is not new, as it was used by the writer quite a number of years ago for precisely the same purpose.)

In connection with Lord Kelvin's new wattmeter, described in our last issue, Dr. Fleming suggests to supply the current for the shunt coil by means of a small transformer, the primary of which is connected to the mains; this overcomes the use of a very high non-inductive resistance which necessarily wastes quite a little power. This applies to high tension mains rather than to those using low tension.

High Resistances.—Dr. Fleming, in a recent lecture, showed some high resistance material made of a mixture of plumbago and Stourbridge clay made in the forms of rods about one-fourth inch in diameter and 5 or 6 inches long, baked similarly to plumbago crucibles. By varying the proportions of clay and plumbago the specific resistance may be made anything that is desired; a half-and-half mixture, for instance, is said to have a resistance about 4,000 times as great as german silver wire; these rods dissipated energy at the rate of about one watt per square inch; the temperature coefficient may be reduced to almost nothing or may even be made negative; they will, of course, be non-inductive.

Practical Rules.—The Lond "Electrician" says: A copper wire one-thousandth of a square inch in cross-section runs 12½ feet to the ohm. The area of a circle is approximately the square of the diameter less one-fifth of this.

DYNAMOS, MOTORS AND TRANSFORMERS.

Testing Alternators.—Mr. Mordey, in a paper read before the Inst. of Elec. Eng., published in part in the Lond. "Elec. Eng.," Feb. 24, describes a very interesting method of testing alternators. He calls attention to the difficulty of testing large alternators, as more power is frequently required than is available at the factory. After reviewing Hopkinson's well known method, in which two equal dynamos are coupled, and Lord Rayleigh's suggestion to supply the power by an accumulator or small dynamo instead of a belt (thus making the method completely electrical), he describes his own method for testing alternators in a similar way. Two equal alternators may also be coupled mechanically and driven by a direct current dynamo, but he states it is often much more convenient to be able to test a single alternator; this may be done very easily with his machine (in which the armature is stationary) under all the ordinary conditions of full load, with only a small absorption of power. This is done by dividing the armature circuit into two portions and connecting them together so that one has a higher E. M. F. than the other; the stronger portion will then act as a generator, absorbing power, and driving the current through the weaker portion, which acts as a motor, returning the power to the generator portion, less the losses. The electrical inequality in the two halves of the armature may be obtained by dividing the armature into two unequal portions, which are joined up so as to oppose each other; any required current may thus be made to circulate through the armature and may be measured by an ammeter in circuit; the volts are also measured across the junction. When the current, speed and field are all normal, the machine will be working at full load, so far as internal mechanical strains and electrical losses are concerned, and the power to drive it will be merely that required to make up the mechanical and electrical losses; the efficiency is then readily calculated. He then describes such a test made with a 250-kilowatt alternator, giving the figures. He believes that the eddy currents are less when loaded than when on open circuit.

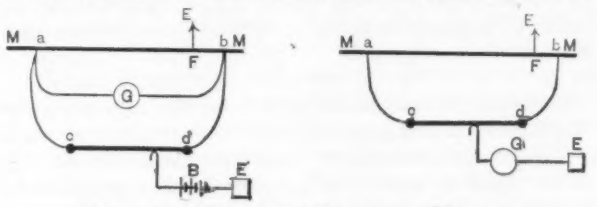
Another way to produce an inequality in the two portions of the armature is to connect the secondary of a transformer, in the armature circuit, the primary being connected across the junction of the two portions, or wherever convenient; the E. M. F. supplied by the transformer causes the necessary circulation. He tried this to prove that it will work, but made no actual tests. The power in these tests has to be supplied and measured mechanically, which may be done by transmission dynamometers or indicator diagrams; but as these are both unsatisfactory, he suggests using an electric motor, preferably directly coupled, so as to avoid the use of belts; the power of the motor may then be measured electrically and due allowance made for its efficiency.

The only fully satisfactory method, however, is by a direct electrical measurement of the whole of the losses. To do this he suggests dividing the alternator, as before, into two portions; then run the machine up to synchronism with another alternator, which may be of about half the capacity; one portion of the large alternator is then run as a motor, driven by the small alternator; while the other half acts as a generator doing work on an external circuit, the machine to be tested acting exactly like a continuous current transformer, known as a dynamotor; the belt is thrown off from the large machine as soon as it is electrically coupled with the smaller one. These tests involve the assumption that the efficiency, as a motor, is the same as that when it is a generator, which he thinks is an allowable assumption. He gives particulars of a test made in this manner.

Prof. Ayrton, in discussing this paper, states that the test could also be applied to alternators with moving armatures; also to multipolar direct current machines by opposing the halves of the field magnets, and driving by a motor; the efficiency of direct current machines could thus be tested without the necessity of having two commutators. Prof. Thompson stated that the exact conditions of practice were not assured; a motor driven by a generator is not rigidly attached and is therefore not in exact opposition of phase.

Coupling Alternators.—Mr. Mordey gives the following necessities for running alternators in parallel: Each alternator is driven by a separate engine; all the engines are in parallel on the same steam pipe; all the alternate fields are magnetized in parallel; all the armatures are in parallel and supply current to the mains at the same pressure; each alternator gives its proper proportion of load by regulating the steam; the regulation of the pressure is controlled by the common exciter.

Alternate Current Motor.—Regarding the alternate current motor of Mr. Brown, described some weeks ago, Messrs. Hutin & Leblanc state that they invented it in



METHOD OF LOCATING FAULTS IN MAINS.

1890, and referred to "La Lum. Elec.," May 30, 1890, p. 418. This article is of a mathematical character and contains illustrations of a 15 kilowatt motor which had been built in Paris.

Multiphase Generator.—The "Elek. Anzeiger," Jan. 29, contains an illustrated description, apparently from a patent specification of 1890, of the multiphase generator of Hutin & Leblanc, in which condensers are used. (As multiphase generators are so easily constructed it seems unnecessary to resort to condensers.)

In the Lond. "Elec. Eng.," Feb. 10, Mr. Guy, in his serial on the dynamo, discusses the subject of the magnetic circuit. The matter is not new, but is well written and is intended for students and amateurs. In the issue of Feb. 24 he discusses the subject of alternate and direct current dynamos.

ARC AND INCANDESCENT LIGHTS.

Repairing Incandescent Lamps.—A German firm in Munich is making a business of renewing the filament in incandescent lamps; the glass globe is opened at the upper end, the filament is removed, a new one inserted, which is secured to the leading-in wires by means of a new cement which becomes a conductor by passing a current through it; the lamp is then sealed and exhausted as usual. This is said to cost 25 per cent. less than the cost of making a new lamp. The sealing is said to be so skillfully done that it is impossible to tell whether the lamp has been opened or not. It is stated that experts have been unable to tell the difference between a lamp that is thus repaired and a new lamp.

Diffusion of Light.—In the issue of March 4, under this heading, was given an abstract of the first part of a paper by Mr. Sumpner; the second part being of such a nature that it could not be abstracted, and being a paper of great importance, as it is one of the first of its kind on this subject, will be reprinted in another part of this issue. It is recommended to all those interested in the subject of illumination. Among other things, for instance, he shows that the white reflector, under certain circumstances, reflects more light than a mirror reflector.

Leading in Wires.—Dr. Langhans states that an alloy of iron, nickel and antimony platinized has nearly the same coefficient of expansion as glass, and will therefore serve as leading-in wires. A German journal says that an alloy of copper with 95 per cent. of tin can be fused to the glass and has nearly the same coefficient; its melting point is 360 degrees C. The Lond. "Electrician" doubts the truth of these statements; it gives the coefficient of glass as 0.00089 and that of platinum as 0.000863; that of cast iron is 0.001. (Instead of theorizing, why would it not be best and quickest to try these metals by making a few lamps and running them? This would be but a small expense for an incandescent light factory.)

Mr. Bussmann states that it has been shown by a very large number of experiments that the resistance of a carbon filament of a lamp is from 1.5 to 2.2 times as much when cold as when running normally; the difference depends on the mode of manufacture of the filament; for gradually increasing potentials the resistance at first falls rapidly and after a red heat is reached it continues to fall slowly up to the normal white heat.

Arc Lamps.—The Lond. "Elec. Rev." describes and illustrates the new Pilson lamp for alternating currents, also one for photographic work with alternating currents. As in the well known Pilson lamp (described in every text book) the cores are tapered. The photographic lamp is made with a large white parabolic reflector, the whole being suspended by a universal joint. The lamps will run with any frequency. For photographic printing the light is spread by a reflector over a circle of 8 feet in diameter, in which 4 to 5 dozen prints can be made in 20 to 30 minutes; the current required is 30 amperes.

The "Elek. Zeitschrift.," Feb. 17, describes and illustrates an apparatus for showing the operation of an arc lamp at a public lecture. The apparatus is simple, every part of it being clearly visible; a long lever moving over a scale indicates and measures the length of the arc.

TRANSMISSION OF POWER.

The sixth and last lecture of Prof. Unwin is reprinted in the Lond. "Electrician," Feb. 24. It deals with distribution by steam, by gas and, lastly, by electricity. The latter is somewhat disappointing. Among some of the statements made were the following: That electricians had forgotten that there were other means of transmitting power, and that "if electrical transmission was to become important" it must be cheaper than the other methods. (Are there not other advantages of electrical transmission besides economy in transmission?) "Electric lighting appeared to have succeeded, although it was too early (!) yet to estimate the measure of its success." He "could not discover that the cost of electrical traction was, except in very favorable cases, much lower than the cost of horse traction." He states that electricity was likely to achieve success for underground and overhead railways, especially for frequent service. He states it was possible that even in working cost the electric motor would be cheaper than the steam locomotive. He describes at some length two continuous current plants in Switzerland. He states that, as far as he knew, the three-phase method has proved to be an expensive method of working. Looking at accomplished results he states that electricity generated by steam was nowhere supplied at less than $150 to $200 per horse power per year, exclusive of their cost, and that there was no prospect of a reduction in the cost of electrical distribution. (The same journal announces reductions for power purposes, made by several of the London central stations.) He thinks that the limit of improvement of steam engines had very nearly been reached; with gas engines there was probably a larger, though not very large, prospect of reducing the cost of producing power. He concludes by saying: "The chief hope of reducing the cost of power distribution would be by combining the supply of as many demands as possible."

RAILWAYS.

High Speed.—Mr. Kraemer in the "Elek. Zeitschrift" states that the theoretical maximum speed of a motor on rails is 310 miles per hour on a level, with curves not less than 12 miles radius and with 12 feet driving wheels; he doubts whether the proposed speed of 150 miles an hour on the projected Budapest line is feasible, and suggests that the practical maximum would probably be 120 miles per hour. (Prof. Wm. D. Marks, some years ago, stated that the theoretical maximum limit of speed was reached when the wheels burst from centrifugal force, and that this limit was the same, no matter what the diameter of the wheels; from this he concluded that the maximum practical speed was 2½ miles per minute, or 150 miles per hour. The above figure, 310, does not agree very well with this.)

High Speed Lines.—Mr. Karis stated that the cost of construction of the proposed Vienna-Budapest high speed line would amount to 2½ times that of an ordinary railway; even if the whole of the present traffic, amounting to 200,000 passengers per year, were diverted to this road he thinks it would not provide for depreciation and interest; he suggests reducing the speed to 93 miles an hour, stating that it may then become practical.

Dr. E. Hopkinson read a paper before the Inst. of Civil Eng. (Lond.) on electric railways, devoted chiefly to a

technical description of the City & South London Railway. An abstract of this paper will be found elsewhere in the present issue.

Liverpool Road.—The Lond. "Elec Eng." Feb 10, concludes its description of this road, giving a number of illustrations of the interior of the stations and the truck.

Lond. "Engineering" gives a calculation of the energy required for operating the signals of the Liverpool Railway, showing that the total expenditure on the whole railway per day amounts to 6¼ kilowatt hours.

Lond. "Industries" questions whether earth returns will not have to be abandoned for railway work. On a long line there may be a drop of many volts along the return conductor, which means considerable leakage, and leakage cannot exist without electric corrosion.

An underground railway, similar to the City & South London line, is to be built in Brussels; there will be eleven stations; the train is to consist of only one car, carrying 40 passengers; there will be eleven cars running in each direction; an automatic electric block system is to be used; the elevators are to be operated electrically.

Mr. Tanner in the Lond. "Elec. Rev." gives some interesting facts regarding the first electric railway, devised and constructed by Siemens in 1879, using a third rail conductor. He believes this to be the first one proposed and constructed, which actually conveyed passengers. During 119 days this railway conveyed 80,924 persons.

SYSTEMS, INSTALLATIONS, CENTRAL STATIONS.

High vs Low Tension.—Dr. Fleming, in his discussion, given partly in the Lond. "Elec. Rev.," Feb. 24, p. 231, states that the economical radius of supply by three-wire direct current systems is reached at distances when the feeders have an average length of somewhat less than 1 mile, with load diagrams of 10 per cent.; and that the case becomes much more unfavorable to the low pressure supply if the load diagram improves. In all cases, therefore, in which large load factors are expected, he advises selecting the alternating current system. Unless all the circumstances of the load are stated, he states that one is not in a position to definitely say which method has the advantage in point of economy.

Some of the London central stations have announced a reduction in the price of electrical energy to 6d. (about 12 cents) per kilowatt hour, with a sliding scale for considerably lower prices according to the amount consumed. The central stations of Berlin have reduced the price of a kilowatt hour to 20 pfennig, equal to about 5 cents. This, we believe, is the lowest price of any central station in a large city.

Central Stations.—The Lond. "Elec. Eng." Feb. 24, contains a technical description, giving data, of the installation at the Brussels postoffice, which is said to be a model installation. The "Elek. Echo," Feb. 11, contains a description of a large number of the central stations installed by the firm of Siemens & Halske, with three large illustrations of interior views of the Breslau station—one of a switchboard, one of a battery room and one of an engine room. A detailed statement of the accounts of the St. Pancras station is given in the Lond. "Elec. Rev.," Feb. 24, and also, though not as complete, in the Lond. "Elec. Eng." The "Elek. Zeitschrift," Feb. 17, gives a tabulated statement of the number of lights and motors of the central stations in Berlin.

The "Elek. Zeitschrift," Feb. 17, gives an illustrated description of a portable lighting plant. The boiler, engine and dynamo are arranged in a compact form, on a four-wheeled iron wagon, from which connection can be made to a temporary installation. In large cities where such temporary illumination is wanted frequently, such an apparatus might be very useful.

The Lond. "Elec. Eng.," Feb. 24, gives an illustrated article on electricity at the theatres, showing a number of the striking effects produced in some of the London theatres.

WIRES, WIRING AND CONDUITS.

Concentric Wiring.—Mr. Mavor, in the Lond. "Electrician," Feb. 17, criticises very unfavorably the usual system of wiring with double conductors, pointing out its weak points, among which are the following: There are a very large number of parts; there is too much "crockery" used; every screw and unsoldered contact is a weak point; wood casings are objectionable, and can never be made absolutely fireproof. He urges very strongly the adoption of concentric wiring with uninsulated return, which, he says, overcomes all these objections. The outer contact of a concentric wire should have equal conductivity to that of the centre wire, and must form a complete and continuous metallic envelope or sheathing; it should not only be uninsulated throughout, but should be grounded. Fuses, cut-outs, switches, etc., should be in the centre wire circuit and entirely inclosed in metallic boxes, which form parts of the outer conductor. In such a system there is only one vulnerable part, and this is protected by the metallic sheathing. If a leak develops between the inner and outer conductor, it immediately becomes a short circuit and blows the fuse; the spark is entirely within the sheathing and therefore cannot communicate fire; he therefore claims that concentric wiring is absolutely fireproof. (It is wellknown that dampness in wooden cases may allow sufficient current to leak out to set the wood on fire, but not enough to blow the fuse; when the wires are close together, however, any leakage immediately develops into a short circuit before any damage can be done.) He states furthermore than concentric wiring may be made waterproof, for instance, by a sheathing of lead under or over the outer conductor. (Why not use the lead sheathing as the return circuit?) He recommends concentric wiring especially for ship work, where it is already largely in use; also for petroleum vessels where the fire risk is great. The insulation in concentric wiring, he states, is very much higher than in the usual double wiring. All switches, fuses, etc., are made water-proof by being in the form of cast brass boxes. He claims that there has been a projudice against concentric wiring which has now almost disappeared.

TELEGRAPHY, TELEPHONY AND SIGNALING.

Music by Long Distance Transmission.—The "Zeitschrift f. Elek.," Feb. 1, contains an illustrated description of the long distance transmission of music from Munich to the city of Frankfort, during the recent electrical exhibition. The arrangement is that of Mr. Berliner; the distance is 270 miles; the circuit was entirely metallic; 60 Callaud cells were used in 15 series of 4 each; the current from these passed through 9 microphones in multiple arc, thence through the primary windings of 6 large induction coils in parallel. A very large number of experiments showed this to be the best arrangement, as the influence of the extra currents is said to be diminished, and as, with the present low resistance lines, transmission depends less on high voltage than on great current strength in order to overcome the leakage of current from the line; at low voltage the leakage will be proportionately less, and with strong current strength it will be relatively much less. He found, for instance, in a long line that an induction coil of 50 ohms resistance of the secondary and a wire .28 millimetres in diameter, gives as good results as a coil of 180 ohms resistance and a wire of .20 millimetres, the primary circuit and transmitter being the same. The 9 microphones were placed in different parts of the Opera House, thus having the effect of a person listening in different parts of the auditorium at the same time.

Telephonic News Distribution.—In the city of Pesth (Budapest), in Hungary, a system, which might be termed a "telephonic newspaper," has just been started; the latest items of news are sent out from a central telephone office to a large number of subscribers. The news is received at the central office, where it is properly edited and then sent out over telephones. The subscribers may receive the news while at work by having a telephone continually secured to the ear. The service commences at 8 in the morning and lasts until 9 in the evening. (If news was thus distributed at certain fixed times, say, at every half-hour, such a system might become practical in this country also.)

Quadruplex.—The Lond. "Electrician," Feb. 3, reprints a paper of Mr. Keeley, read before the Canadian Society of Civil Engineers, on the simplification of the quadruplex and the importance of its achievement. He states that there is an inherent defect in the present system of quadruplex, to avoid which complex apparatus had to be introduced; he shows how, by building up a different but equally simple principle, the same practical results can be secured with much less apparatus. He then proceeds to describe and illustrate this apparatus.

Telegraphy.—"L'Electricien," Feb. 11, concludes its illustrated description of the printer of Mr. Wright. Mr. Wilkinson's serial on submarine cable work is concluded in the Lond. "Electrician," Feb. 17. The Lond. "Elec. Rev.," Feb. 17, contains an interesting narrative of a telegraphic expedition in the Chin country, in Eastern Asia.

The Government and the Telephone.—The Lond. "Elec. Eng." states in an editorial: "Telegraphy was in the hands of the government, and the advisers of the government made a fatal error in refusing to take up telephony. That mistake will yet cost them millions, and will serve the nation right. We hold that the government officials have made almost every possible blunder that business men could make in regard to telephony, and have in the long run landed us into the hands of irresponsible monopoly."

The Siemens Telephone with siren call is illustrated and described in the Lond. "Elec. Rev.," Feb. 24. It consists essentially of a small armature which is rotated by means of a little crank, between the two poles of the bipolar telephone magnet, which induces an alternating current, producing a buzzing noise; this may be intensified by a little ball attached to a string and resting on the telephone diaphragm; the telephone in that case must stand up vertically, when not in use.

The Groper microphone, according to the Lond. "Electrician," consists of a diaphragm of mica .04 millimetre thick and another of carbon separated by a layer of air; at the back of the carbon disc are several sloping tiers; on each are a row of balls of carbon, the front row of each tier resting against the carbon disc.

Telephony.—The "Elek. Anzeiger," Feb. 19, contains an illustrated description, apparently taken from a patent specification, of an improved individual call. The Lond. "Elec. Rev." gives an illustrated description of the new Western Electric switchboard.

The "Zeitschrift f. Elek.," Feb. 1, gives the telephone statistics for Germany for the years 1890 and 1891.

"L'Electricien" claims that the hydrophone of Mr. McEvoy, at present used in England, was the invention of the Frenchman Banare. It is presumably a sort of microphone placed on the bottom of the sea at depths of 8 to 25 metres, in an iron bell weighing about 350 pounds. It is said to indicate the presence of a steamer within 700 to 800 metres of a buoy or torpedo.

ELECTRO CHEMISTRY.

Stripping Tin from Tinned Iron.—According to the process of Naef, scraps of tinned iron are suspended in a lead vessel containing a solution of tin; the tinned scrap forms the anode and the vessel the cathode. The tin is deposited on the vessel as a metallic slime. In the new process of Rayund the solution is protochloride of tin, acidulated with hydrochloric acid and having a density of 5 to 6 degrees B. The voltage required for a bath is from three-fourths to 1½.

Palladium Plating.—An article, under this heading, in the Lond. "Elec. Rev." gives a summary of the history and properties of this metal, but says nothing about plating, except that it was practically accomplished at present by a certain company, and that articles now silver plated would in future be coated with palladium instead, owing to its superior qualities.

A German firm is experimenting with a commercial process for producing alkaline ferricyanides by electrolysis. In the chemical or ordinary electrical process impurities are formed which are now overcome in the electrical process by conducting the oxidation in the presence of an alkaline earth salt, such as calcium ferrocyanide.

Electro-Deposition on Glass.—In the process of Mr. Pottier, the article is decorated with a paste composed of finely divided silver, plumbic chlorate and oil; it is then heated to a moderately high temperature, during which a strongly adherent film is produced, on which the electrodeposition can then be made with great facility.

Artificial Diamonds.—Mr. Moissan makes diamonds by placing about 200 grammes of a mixture of cast iron and carbonized sugar in a crucible of carbon resting in a bed of magnesia, the whole being placed in his furnace (described elsewhere in these columns). After five or six minutes the crucible and its contents are plunged very quickly into cold water. The interior is thus subjected to a high pressure which solidifies the carbon; on dissolving the metal with acid a number of very small diamonds are found.

Lond. "Industries" describes an apparatus for indicating the progress of fermentation, consisting of a pair of battery plates inserted in the fermenting liquid and connected to a galvanometer; as the liquid becomes acid the deflection of the galvanometer increases rapidly; an alarm bell may thus be worked by means of a suitable relay.

MISCELLANEOUS.

Electric Furnace.—The Lond. "Elec. Eng.," Feb. 24, gives a description of Moissan's electric furnace. It is formed of two bricks of quick lime, cut very true and laid upon one another. The lower brick has a longitudinal slot, which carries the two electrodes and has a small cavity in the centre, which forms the crucible; a small crucible of gas carbon may also be inserted, containing the material to be acted upon; a hole may be pierced through the upper brick to allow for introducing small pieces while the furnace is in action. After each experiment the end of each carbon was found to be entirely transformed into graphite. In some tests currents of 30 amperes and 55 volts were used, the temperature being about 2,250 degrees C.; in another test with 100 amperes and 45 volts, the temperature was about 2,500 degrees C.; in still another, 450 amperes and 70 volts were used, the temperature being about 3,000 degrees C. (As Mr. Violle has shown that the temperature of the arc is constant, these differences in the temperatures were probably due to differences in the radiation of the heat.) Electric sunstrokes were frequent in making these tests, until proper precautions were taken to avoid them. At 3,000 degrees the furnace itself melts and runs like water. He states that it is very easy to experiment with this furnace even at a lecture, as it requires but 10 minutes to heat the furnace. He also gives the results of a number of the tests made with various substances.

The Ries Improved Universal Base Regulating Socket.

The Ries regulating socket is the invention of Mr. Elias E. Ries and has through the efforts of its manufacturers, the Ries Electric Specialty Company, corner Baltimore and Eutaw streets, Baltimore, Md., been so successfully placed before the public of late that its name is now well known to all those who are connected in any way with electric lighting.

The Ries socket as now manufactured by the Ries Electric Specialty Company embraces a number of important improvements that render it superior in

FIG. 1.—RIES REGULATING SOCKET.

every way to those first placed upon the market. Figs. 1 and 2 give views of the improved socket.

To secure a supporting block that would be thoroughly reliable, safe and permanent was a matter of considerable difficulty. These contact blocks originally made of wood and afterward of hard fiber and other substances of a fibrous character, which failed to give entire satisfaction, are now formed of a porcelain block devised by the inventor, which meets in every way the requirements to which it is subjected.

The reaction coil consists of a small finely laminated annular iron core 1¼ inches wide and ¾-inch high, built up of very thin specially treated iron rings carefully assembled and taped. This core is evenly and skillfully wound by hand with an insulated cable composed of seven separately insulated copper wires varying in size according to the maximum current that each is required to carry, the wires being of different colors to facilitate their proper connection. The ends of this cable are bared and threaded through a double series of holes in the porcelain supporting block, in such a manner that when the copper contact or terminal pins are driven home and clinched at the back of the block all of the several wires of the coil are connected in series, the winding being divided by the contact pins into seven sections of equal length. The operating key of the

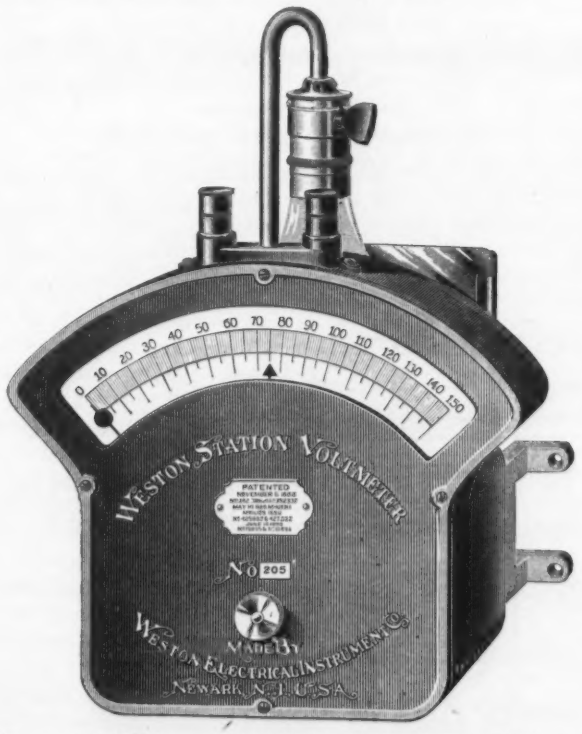
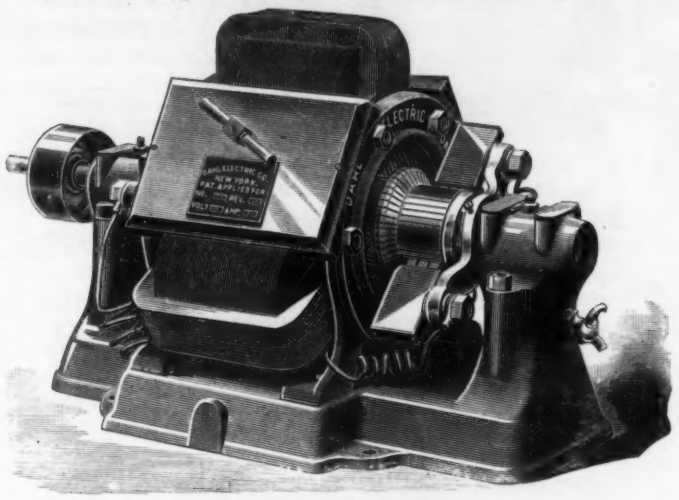

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
WESTON STATION VOLTMETER
PATENTED
No 205
MADE BY
WESTON ELECTRICAL INSTRUMENT CO.
NEWARK, N.J. U.S.A.

FIG. 1.—WESTON STATION VOLTMETER, STYLE A.

socket, which has its bearings and projects through an opening in the inclosing shell in the porcelain block, is provided with a contact arm that moves over the series of the terminal pins, and by including a fewer or greater number of coiled sections in the lamp filaments the circuit diminishes or increases the candle power of the lamp. The resistance of these coils is so low that the actual waste of energy is practically negligible, the current being choked down by the self-induction of the coils.

When the lamp is burning at the lowest stage the filament is at a dull red, emitting just enough light to locate its position upon entering a dark room. It is claimed that on an ordinary 50-volt alternating circuit with a 16-c. p. lamp it will consume at this notch one-fifth of an ampere with an effective electromotive force of about 10 volts or a total energy of two watts, as against 50 watts when burning at the normal candle power, or only one twenty-fifth of its normal energy, excluding certain minor losses.

Heretofore it has been necessary in ordering sockets to specify the particular make of lamp for which they were designed, but the new universal base shown in Fig. 2, with which the Ries regulating sockets are now provided, obviates this difficulty. The centre contact is a hollow slotted stud provided with the standard Thomson-Houston lamp thread upon its outer surface, its interior



DAHL ELECTRIC MOTOR.

being of the proper diameter to receive the centre pin of a standard Sawyer-Man or Westinghouse base lamp, while its exposed end is arranged to bear against the disc of the standard Edison lamp base.

The Ries regulating socket is at present manufactured and wound for 50 and 100 volt alternating circuits respectively.

Motors for Alternating Current Circuits.

Mr. Olof Dahl, of the Dahl Electric Company, 126 Liberty street, New York City, has produced a motor, which can be connected to any of the ordinary single phase alternating systems, and a number of them are already in daily use. These motors can be made in any size, from one h. p. upward, are synchronous, hence must run at a uniform speed, provided the generator runs steadily, and are self-excited, starting themselves vigorously with a torque about equal to their normal capacity. They have a commercial efficiency equal, if not superior, to the best direct current motors, the one h. p. size having an efficiency of 75 per cent. and increasing with the size of motor up to over 90 per cent. There is no undue heating in any of the parts, and neither armature nor field coils rise in temperature more than 30 degrees above the surrounding atmosphere under normal load, and there is no heating of the field cores. Should the motor be stalled, which takes at least 50 per cent. overload, the armature

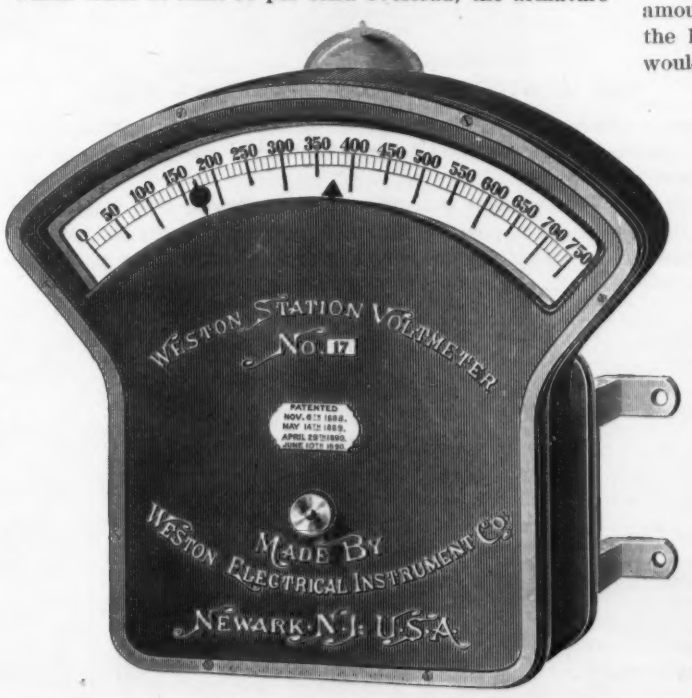

0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750
WESTON STATION VOLTMETER
No. 17
PATENTED
MADE BY
WESTON ELECTRICAL INSTRUMENT CO.
NEWARK, N.J. U.S.A.

FIG. 2.—WESTON STATION VOLTMETER, STYLE B.

is not injured, as the self-induction chokes back any abnormal current.

This motor is designed to operate on the alternating system in use at the present time, without any reduction in the number of alternations, which is called for in the use of the multiphase, involving as it would more expensive transformers, greater in weight proportional to the reduction of alternations.

Thus it is claimed that it is possible at once to increase the earnings of our alternating central stations without the slightest change in our system of distribution. From the lines already erected and from the same transformers used for lighting at night, motors can be operated in the daytime, and both motors and lights at night, if the capacity of the transformer is sufficient.

The Weston Standard Station Indicating Instruments.

The necessity of thoroughly reliable indicating instruments for use in central stations of every character is now becoming widely recognized. Accurate and trustworthy instruments are as much a factor in the safe and efficient operation of any generating plant as the steam gauge is in the running of a boiler. Recognizing this uni-

FIG. 2.—RIES REGULATING SOCKET.

versal demand, the Weston Electrical Instrument Company, of Newark, N. J., has sought to obtain a type of instruments which would embody the qualities vital to this class of work and avoid the defects incident to the common styles in use. A series of station indicating instruments for use on direct current circuits has accordingly been brought out by the Weston company, which bid fair to attain the success which the widely known standard portable Weston apparatus has attained.

To be of any real value an indicating instrument must be theoretically correct in principle, accurate throughout its entire range, simple in construction and economical in operation. The principle embodied in the Weston instruments consists in the simple movement of a small coil through a uniform magnetic field against the opposing force of a very light spring. By avoiding the use of all moving iron parts, magnetic lag is entirely eliminated. As to the accuracy of the intrument, suffice it to mention that the very principle of its construction, involving a perfectly uniform magnetic field, forces the coil to which the pointer is attached in the Weston instruments, to take up a position corresponding exactly to the amount of current passing through it. In construction the Weston instruments have but a single moving part, consisting of a little coil weighing a small fraction of an ounce, and to which the pointer traversing the scale is directly attached. These instruments have, moreover, been designed to operate with a very small amount of energy. In the station ammeter, for example, the loss is so small that 25 1,000 ampere instruments would absorb about 1 h. p. Over 120 voltmeters of the

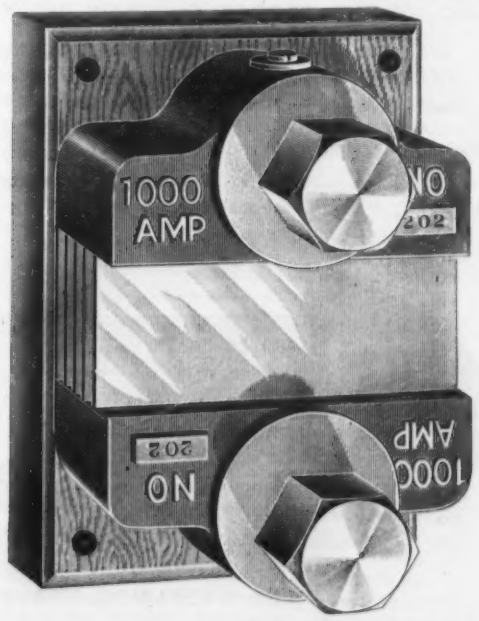


FIG. 3.—WESTON ALLOY SHUNT.

Weston type in a railway power station operating at 550 volts would absorb about a horse power, while on 110 volts nearly 750 would take no more.

The Weston illuminated dial station ammeter is based upon the same general principle as the regular standard portable direct current ammeters, but is much larger, and the working parts are inclosed in a neatly designed cast iron case. This case is dust proof, to protect the working parts from mechanical injury. It also effectively shields the instrument from disturbing influences of external magnetic fields. The instrument depends for its operation

upon the fall of potential between two points of the circuit carrying the main current, and requires a difference of only about .03 volt to give the full scale deflection, the current in the instrument being only .07 ampere, no matter what the total capacity of the instrument may be. Unlike the regular portable instruments, the shunt required to secure the necessary fall of potential is not included in the case, but is separate from it, and is desgned to be placed at the back of the switchboard.

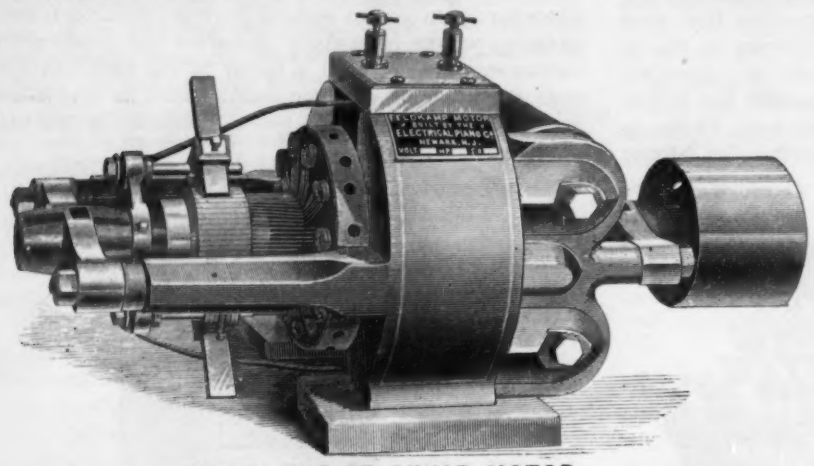


FIG. 2.—THE FELDKNAP MOTOR.

Two styles of shunts are made for use with these instruments. One style is made of copper, and is somewhat more accurate than the other, but is also much larger and more expensive. The other style, Fig. 3, consists of one or more sheets of a special alloy.

The central station and isolated plant astatic ammeter which is of the electromagnet type, and has been expressly designed to meet the demand for a good, moderate-priced, dead-beat ammeter, the indications of which may be relied upon, even under rapid and great fluctuations in the strength of the current, and which, at the sume time, may be used in the presence of the most intense magnetic fields, without materially affecting the readings. These instruments are provided with a peculiarly shaped field, to utilize as perfectly as it is possible the magnetizing effect of the current passing through the conductor, and so to secure the most intense field possible for a given length of conductor. The instruments are metal cased throughout, and are so constructed as to render displacement of the operative parts in relation to each other impossible. They are so astatic that they may be used on the yokes or pole pieces of dynamos or motors, without materially affecting the read-

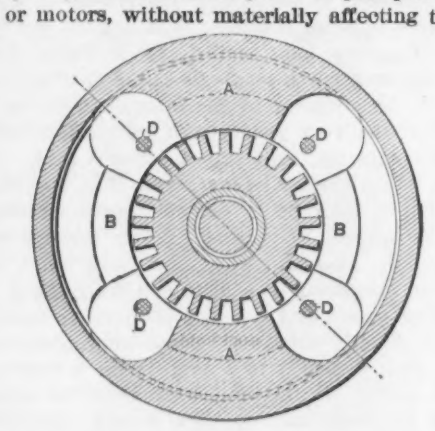


FIG. 3.—THE STOREY ELECTRIC MOTOR.

ings. They are just as dead-beat as the regular portable standard instruments.

The illuminated dial voltmeters are made in two sizes, which are designated as style "A" and style "B." The smaller one is style "A," Fig. 1, the larger one style "B," seen in Fig. 2. Both sizes are based upon the same principle as the portable standard direct current voltmeters, and embody all the latest improvements suggested by Mr. Weston's researches on these instruments down to the present moment. Like the illuminated dial ammeter, the voltmeters are inclosed in nearly designed dust proof cast iron cases, which perform the double function of protecting the working parts, and effectually shielding the instrument from the disturbing influence of external fields. They are provided with the same kind of scales and the same devices for illuminating the scales, as are used with the ammeters. They have two indices. One of these is the indicating index, and has a fine point for close readings, with a blackened aluminium target disc, which, in conjunction with the other index termed the "normal index," enables even a slight deviation from the normal voltage to be seen from a long distance.

The isolated plant voltmeters, in their electrical and mechanical features, are in every way the equal of the portable standard voltmeters and illuminated dial station voltmeters. The case is of cast iron, neatly finished, affording effectual protection against external magnetic influences. The scale of these instruments is drawn on stout opaque paper, and hence cannot be illuminated from the rear. This makes the construction of these instruments much cheaper.

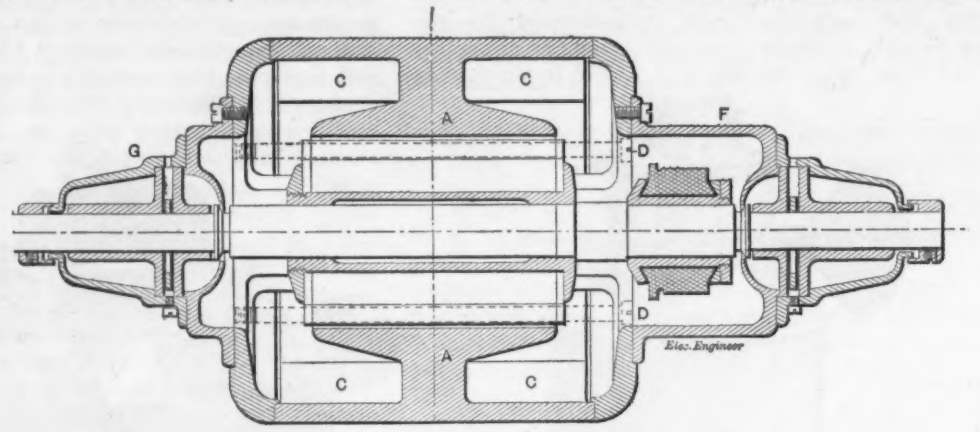


FIG. 1.—THE STOREY ELECTRIC MOTOR.

The Excelsior Track Switch.

In the accompanying illustration is shown a track switch which has recently been put upon the market by the Fitch Excelsior Switch Company, 45 Broadway, New

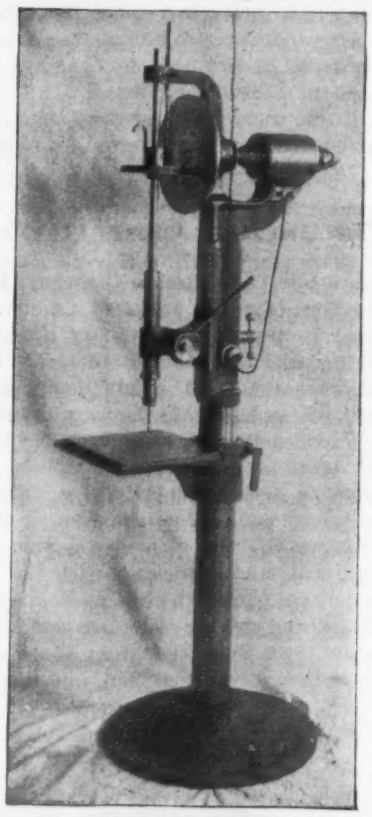
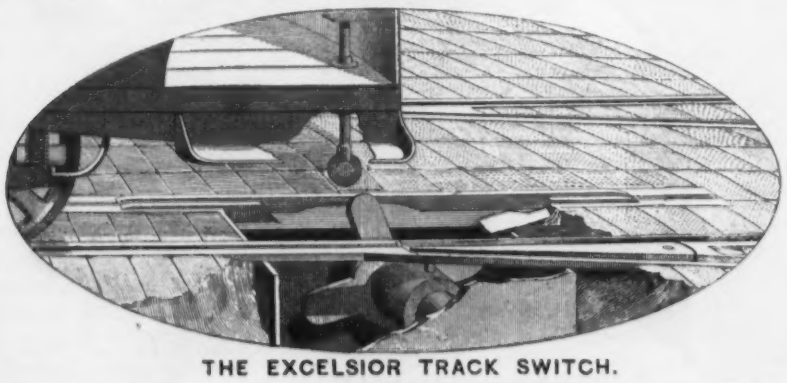


FIG. 4.—STOREY MOTOR OPERATING DRILL.

York City. It is designed for use in cable and electric railways, and can be operated from the platform of a car by the motorman.

Two parallel iron bars placed between the rails form a channel opposite the free end of the switch tongue into which a wheel attached to a rod on the car platform



THE EXCELSIOR TRACK SWITCH.

can be depressed by the foot of the motorman. One of the four radial projections carried on the drum shown in the box under the switch can thus be thrown over, turning the drum one-quarter revolution and moving the tongue to the opposite side. The projections or levers on the drum are so arranged that a continuous rotation of the drum will throw the tongue alternately back and forth. This mechanism is contained in a box only 22 × 18 × 18 inches. The switch has been put to some severe tests on the Steinway Street Railway, Long Island City, N. Y., where it was demonstrated that it will work surely and accurately.

The Storey Electric Motor.

Until very recently electric motors have simply been used to supply the place of engines and other prime movers; that is, to transmit power by means of shafting and belting. It is evident that in this sphere the electric motor does not possess many advantages over other forms of motive power, save in convenience, in economy and in space. If, however, it could be applied directly to the work without the intervention of belts and shaftings, the gain would be one of importance. In 1886, in the mines of Colorado, Mr. I. E. Storey, inventor of the motor which is the subject of this article, turned his attention especially to the production of a motor which should be sufficiently protected to meet the difficulties of ordinary practice, and his first effort was the production of a motor for the direct driving of a mining drill, which was operated under exceptionally severe conditions on account of the moisture and dirt incident to mining work. The successful result of this effort led Mr. Storey to carry the principle further and devise a motor which would be applicable for all classes of work.

In the accompanying illustrations the main point of the construction of the Storey motor is a plain cylindrical machine having end projections for the boxes and commutator.

In Fig. 1 is seen a longitudinal section through the T-

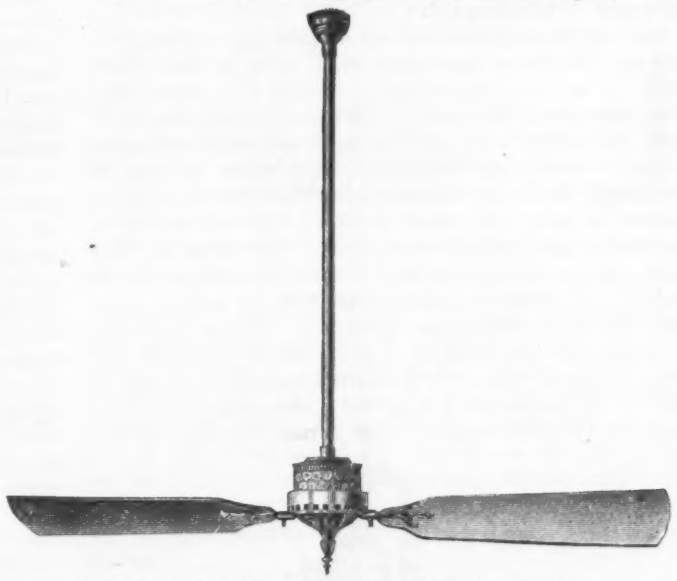


FIG. 1.—THE FELDKNAP ELECTRIC FAN.

shaped pole pieces which project internally from the cylindrical portion of the machine, while Fig. 2 shows a longitudinal section of the poles projecting from the end portions; Fig. 3 is a cross-section through the poles; and Fig. 4 shows the motor applied to the operation of a drill.

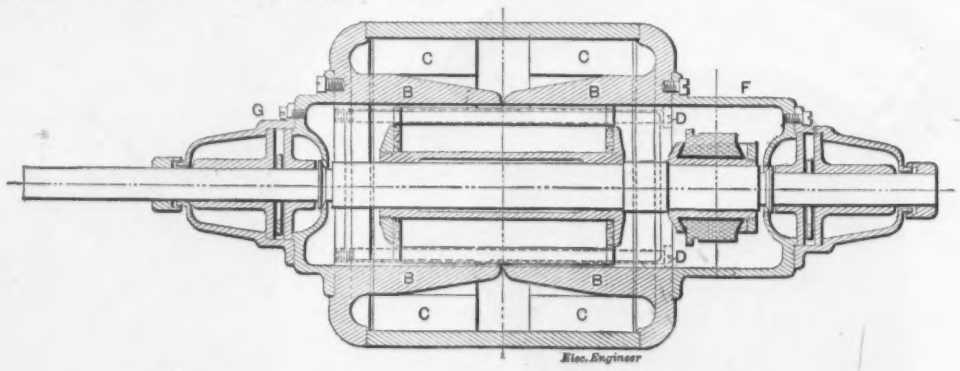


FIG. 2.—THE STOREY ELECTRIC MOTOR.

The machine is four-poled, the centre being of one polarity and the ends of the opposite; it is thus seen that there are eight distinct magnetic circuits, making the path of the magnetic circuit very short and of very low resistance. The coils are wound on spools, thoroughly insulated, and slipped loosely in the cylindrical chamber, occupying a position in a plane perpendicular to the centre line of the shafting.

The armature is of the drum type, toothed; the bearings are of peculiar construction and of such design that the motor can be placed in any position so long as the centre line of the shaft is horizontal. The end of the

caps which serve for supports are protected by a cap projecting over the opening of the boxes, thereby rendering the boxes impervious to dust and moisture. In cases where there is much moisture these are replaced by stuffing boxes. It will be seen that this machine is practically a solenoid, and will be so known. To sum up its important features it may be said to be water, dust and fire proof, which will convince all users as to the great range of work for which it is adapted.

The recent discussions both here and abroad in reference to the applications of electricity to machine tools have called attention to the need of a thoroughly protected motor for this purpose. Mr. Storey has not only sought these qualities, but he has combined, with this, symmetry as well, as is illustrated in the accompanying cuts of a 12-inch upright drill. The examination of this drill will suggest how the motor might be applied to lathes, planers and to other machine tools, as well as all types of machinery requiring constant high speed.

The manufacturers of this motor, the Hornell Iron Works, of Hornellsville, N. Y., are now in the market with motors adapted to grinding and buffing, the operating of drills and small tools and the transmission of small powers.

The Dahl Electric Company, 120 Liberty street, New York City, is the agent of the manufacturers for the Eastern and Middle States.

The Electrical Piano and Motor Company's New Fan and Motor.

The Electrical Piano and Motor Company, 679 Broad street, Newark, N. J., of which Mr. J. Stahl is president, is about to place upon the market an electric fan and a new motor, which possess some interesting features.

EDDY PATENT SELF-LOCKING WINDLASS.

The inventor is Mr. F. A. Feldkamp, who last year secured a patent on an electrical piano.

The fan is shown in Fig. 1. It is light, extremely simple in construction, and at the same time ornamental in appearance. The fan instead of being operated by a separate motor of any distinct type is run by a form of motor which is built into the fan so as to form really a part of it. It consists of an armature and field, made up respectively of six small field magnets and six poles arranged in a circular form, with a flat disc commutator. Only two of the coils are excited at once. This gives a very slow speed, only about 120 revolutions, but a powerful torque, which makes it possible to operate a heavy fan. The chief feature of this fan is the simplicity of its construction and the consequent low first cost. It has been subjected to numerous tests by the inventor, and with excellent results.

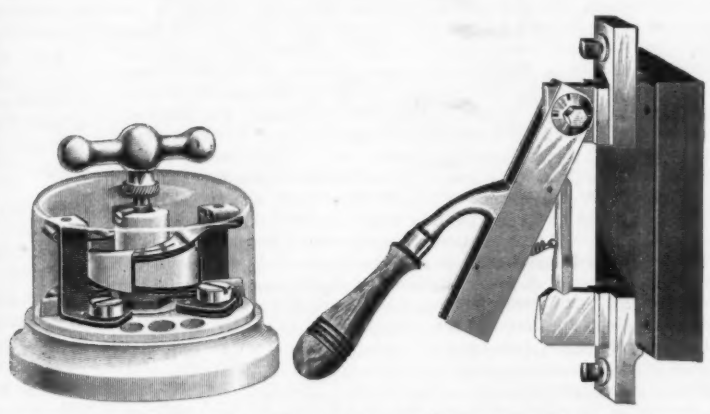
The motor, known as the Feldkamp motor, is shown in Fig. 2. It is built in several styles, but that shown in the cut is the most recent and satisfactory. It is to be made in sizes of from one-fourth h. p. up to 75 h. p., while the dynamo of the same type ranges from one-half h. p. to 100 h. p. The speed varies from 1,600 revolutions per minute in the smaller sizes down to 700 in the largest. The most important details of the construction can be seen from the illustration. The mechanical work is of the highest order, the machine being provided with self-oiling bearings, while at the same time a very high electrical efficiency is claimed. Both the motors and dynamos have perfect automatic regulation, and have practically no sparking under ordinary changes of load. Their slow speed, extreme simplicity and great reliability are the principal points of excellence claimed by the company which is manufacturing them. The smaller sizes have been in successful operation for some time, and it is proposed to build the larger sizes as rapidly as facilities for their construction are prepared.

General Electric Company's New Switches.

We illustrate a snap switch of entirely new design, which owes its creation to the General Electric Company. It differs radically from all other snap switches, and possesses intrinsic advantages of considerable value. The characteristic and distinguishing feature is the ratchet piece, which has four steps arranged in quadrants on both the upper and lower sides and revolves horizontally. One of these ratchet steps is covered with a copper strip passing across the porcelain to the corresponding step on the other side of the ratchet block. Two contact strips of hard spring copper, placed opposite to each other top and bottom on either side, bear upon the copper pieces on the ratchet when the circuit is completed. When the ratchet is revolved, the copper spring pieces are slowly forced apart until the crest of the steps is reached, when they spring to the uncovered steps or quadrants instantaneously, rendering arcing impossible, and placing between them a barrier of porcelain insulation. A similarly forward movement instantaneously makes the circuit.

The General Electric Company has also just put upon the market a feeder switch of an entirely novel design, presenting a reversal of hitherto accepted practice, and one from which many objectionable features present in former types have been eliminated.

In the switch in question, instead of a blade descending jackknife-wise into receiving clips on a slate base, the solid contacts are rigidly mounted on the base, and the clips, operated by the handle, come down one on each side of the contact piece. The switch is so designed as to have all contact surfaces true, this being effected in one operation upon a machine especially devised for the purpose. The soldering of the clips into the lugs is done away with, the lug and contact pieces being one homogeneous piece. The parallel clips are hinged to one contact piece, and are also securely riveted to a piece of metal halfway between the hinge and making end. To this piece is fastened the handle, which projects upward, and then forward at an angle of about 45 degrees. The chief characteristic of this switch is an almost perfect contact surface, having a low coefficient of friction, with high conductivity, the two surfaces acting as if lubricated, minus the additional resistance of a lubricator.



FIGS. 1 AND 2.—GENERAL ELECTRIC CO.'S NEW SWITCHES.

The split blade descending on the contact pieces yields uniformly, and thus makes an ideal contact.

A new method of breaking the circuit, differing radically from all others hitherto adopted, has been introduced in this switch, and no attempt has been made to bring the entire blade portion to a high velocity as in other instantaneous switches. The device by means of which the circuit is thus suddenly broken consists of a short brass bar fastened on the under side of the switch blades, one end pivoted near the middle of the blades, the other being held by a spiral spring, while on the side of the contact post facing the hinge of the switch is a small projection. As the switch is opened, the end of the small bar catches on this projection, and thus remains in full contact until after the blades have entirely left the contact post. When the switch is well opened, the bar slips off the contact post, and is drawn by the spring to its original position against the blades of the switch. These switches are designed for use on circuits of a potential not exceeding 500 volts, and are made in capacities running from 30 to 1,500 amperes.

The Eddy Patent Self-Locking Windlass

A compact and efficient windlass for raising and lowering arc lamps has recently been placed upon the market by the Springfield Foundry and Machine Company, Springfield, Mo., and is meeting with deserved success. The accompanying illustration gives a general idea of its construction. The putting on and taking off of the crank respectively unlocks and locks the windlass, thus saving, it is claimed, from one-third to one-half of the lamp trimmer's time, compared with windlasses that are regularly locked with a key. This windlass cannot be left unlocked. When the crank is in position, it is impossible to remove it without locking the windlass. There being no important openings left unprotected, the sleet cannot drive in, and thereby cause delay and annoyance. The Eddy windlass is at all times ready for immediate use. It can only be unlocked by attaching the crank, and is therefore as safe and secure as though fastened with padlock and key.

The windlass is made of practically three castings, all of which are of good size. There are no small and intricate parts to get out of order.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

NEW YORK, March 11, 1893.

NEW YORK ELECTRICAL STOCK MARKET.

The delayed decline in the values of this class of securities made its appearance this week in a very pronounced downward movement, which can be attributed to special as well as general conditions. General Electric led, going below par. This will be fully treated elsewhere. There was very little inquiry for the inactive stocks and not much disposition to buy bonds except at a sacrifice.

Edison Electric Illuminating.—This stock weakened perceptibly during the week, selling down from 126 to 120¾, closing at 121. The weakness was upon the published news of a proposed issue of $3,500,000 new stock. Of this amount $3,250,000 will be required to retire its outstanding bonds. The remaining $250,000 will be used during the year for the development of the business of the company, and when so used may be issued to the stockholders, probably at par, providing in that way an additional dividend of 1 per cent. A special meeting of the stockholders will be held at the office of the company, at the corner of Pearl and Elm streets, in the city of New York, on the 30th day of March, 1893, at 12 o'clock noon, to take action upon this proposed increase. It will be from $6,500,000, consisting of 65,000 shares of $100 each, to the sum of $10,000,000, consisting of 100,000 shares of $100 each. New by-laws wil also be presented for ratification. For the purpose of such meeting the transfer books of the company are to be closed from the 10th day of March, 1893, to the 30th day of March, 1893, both days in clusive.

General Electric.—The decline in General Electric is attributed to liquidation of holdings purchased during the boom las summer. At that time the stock was run up beyond a price warranted by the conservative views of those most familiar with th property, but pool manipulators were successful in persuading pretty extensive public that it was good for 200, and with this idea in view the stock was placed very generally. The pool is now believed to be out, and in the absence of support sellers sacrificed their holdings to get out. There has been a covert attack on the price by certain leading operators which has quickened th decline. The attack has made a short interest, which is said to b large. The annual meeting of the stockholders will be held early next month, when the first annual report of the company will be presented. We understand the company is in excellent condition. The stock pays 8 per cent., and it is the firm conviction of those most familiar with the property that from the present business outlook this dividend can be easily maintained. The support of the pool being withdrawn from the stock, and the fact being known, caused a general assault on the part of some traders today which carried stock down to 98. After it touched that figure buying orders executed for account of Drexel, Morgan & Co., forced the price back to 102¼.

The bonds were very weak, going as low as 93⅞, and it should not be forgotten that behind the market value of the $10,000,000 of these securities there is an equity of between $10,000,000 and $50,000,000 of those bonds. The buyer of the bonds at 95 has practically a call on the stock for thirty years at 114, instead of at 120, as previously, as the bonds are now selling at 91 and interest. The company must accept them at par and interest, in exchange for the stock at 120. They carry 3½ months' interest. There is more behind this downward movement than appears on the surface, and which has yet to be told. The last lot of $4,500,000 of the debenture bonds which were sold were given to Lee, Higginson & Co., Boston, as that firm agreed to place them for 1 per cent. against a higher commission bid of Drexel, Morgan & Company. It is said upon good authority that the decline was engineered by Drexel, Morgan & Company to punish the Boston firm for its audacity in coming into their stronghold.

The annual meeting of the stockholders of the General Electric Company will be held at the works of the company, Schenectady, N.Y., on Tuesday, the 11th day of April, 1893, at 12 o'clock. The stock transfer books will be closed on Saturday, March 18, at 12 noon, and reopened on Wednesday, April 12, at 10 A. M.

Advices from Boston state that the new steel foundry of the General Electric Company at Lynn, Mass., was started up on Thursday last. It is the largest plant of its kind in the country and will melt and cast thirty tons of steel per day.

Edison General Electric.—There was a routine annual meeting Thursday of the Edison General company, which is the mere shell, so to speak, out of which have grown the other companies. The meeting resulted in nothing important beyond the election of its old officers. The business of the companies has now become concentrated in the General Electric Company, and its meeting and report next month will be the factors of importance in electrical affairs. These trustees were elected for the ensuing year: C. A. Coffin, Charles H. Coster. Thomas A. Edison, S. D. Greene, J. Hobart Herrick, Edward H. Johnson, Arnold Marcus, Carl Schurz, Francis S. Smithers, Samuel Spencer and J. Hood Wright.

Western Union.—The strength of Western Union during the week was due chiefly to covering. The statement for the quarter was regarded as somewhat better than had been expected. Directors have intimated that earnings would be poor, perhaps showing a trifle less than the dividend. Even a small surplus was regarded as good for the March quarter. An operator who covered some Western Union informed us that he bought in his stock chiefly because that offering the price down had failed to bring out long stock in quantity. The election of Gen. Thomas T. Eckert as president of the Western Union has given general satisfaction in Wall street. He is pre-eminently a Gould man, having left the Western Union to take the management of the Atlantic & Pacific at the time that Jay Gould switched over, and was instrumental in bringing to a successful termination the warfare conducted against the Western Union by the Atlantic & Pacific and the American Union. Upon the ascendancy of Mr. Gould to the control of Western Union interests Mr. Eckert followed, becoming general manager of the company and the chief lieutenant of Mr. Gould in the practical management. The new president will continue as general manager, the offices being united.

Following is a comparative statement of earnings and expenses of the Western Union Telegraph Company for the quarter ended March 31:

	1893.	1892.	Inc.	Dec.
Net revenue	$1,675,000	$1,550,000	$125,000	.....
Surplus Jan. 11	6,442,693	12,856,617	.....	$6,413,924
Total	8,117,693	14,406,617	.....	6,288,924
Int. and S. F.	243,335	242,330	1,005	.....
Balance	7,874,358	14,164,287	.....	6,289,929
Dividend	1,184,540	1,077,408	107,132	.....
Surplus	6,689,818	13,086,879	.....	6,397,061

The directors declared a quarterly dividend of 1¼ per cent., payable April 17. The books close on March 20 and open on April 3.

Sawyer-Man Electric Company.—This company, which manufactured the incandescent lamps used by the Westinghouse Company until it was enjoined recently by the United States courts under the Edison patents, filed a notice of voluntary dissolution Friday with Judge Ingraham of the Supreme Court. The court sits June 12 to hear the objections of any persons who may want to oppose the dissolution. Hugh R. Garden, Thomas C. Platt and other stockholders signed the petition. They state that the company has no liabilities and only $4.69 of assets. Trouble may ensue over the proposed dissolution, as the Edison company claims damages against the company for alleged infringement of patent.

American Bell Telephone.—This stock was moderately active in Boston this week, selling through the very narrow range of 202½ to 205. (The highest point this year was 212.) The expiration of one of the primary patents on this company's instrument which occurred on March 8 does not seem to have affected the stock materially. Controlling interests, as well as capitalists generally, make the assertion that the company still controls enough of the devices used in its telephone to assure it a practical monopoly for some time to come. Even were the instrument unprotected by a patent, it is claimed that the gigantic magnitude of the company's operations is of such a nature as to render competition practically impossible, except in an insignificant way. In substantiation of this view, attention is directed to Western Union, which, barring the Postal Company, has a practical monopoly of the business in this country. While the Postal is a keen competitor, it is in business for revenue. If it were not it would not long exist as a competitor. Consequently we find a co-operation between the companies in the matter of rates. It is but logical to assume that this will be the case when the American Bell Telephone Company finds itself thrown into an open market and the directors declared a regular quarterly dividend of three per cent. It is said that the company will authorize the issue of $2,500,000 new stock some time this month.

Commercial Cable Company.—This company has declared a quarterly dividend of 1¾ per cent., payable April 1. Transfer books close March 21 and reopen April 5. One lot of this company's stock, the first that has made its appearance on the exchange in weeks, sold at 185.

The West End Railway System.—This system of Boston, according to current report, has been bought by the Traction Syndicate of Philadelphia and New York. Official confirmation of the purchase is lacking, as well as all details regarding the deal.

Auction Sales.—The following sales of stock were made at auction this week: Five shares Gold Stock and Telegraph at 195; 500 shares North American Phonograph hypothecated, par 100 each, at $3.50; $1,000 6 per cent. first mortgage bonds due 1902, Southern Telegraph Company, at $10; 1 share of American Speaking Telephone at 151; 2 shares of Gold Stock Telegraph Company at 157.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, March 11, 1893, and the range for the week in New York:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Lowest.	Highest.	Bid.	Ask'd.
American District Tel.	100	3,825,000	55	56	55½	59
American Bell	...	.....	102½	205	....	....
Erie Telephone	..	....	45	47	....	....
New England Teleph'ne	..	.....	55	58	....	....
American Tel. & Cable	100	14,000,000	89	90	88	90
Central & So. Am. Tel.	100	6,500,000	....	....	....	111
Commercial Cables	100	7,716,000	185	185	185	190
Gold Stock & Tel	100	5,000,000	..	....	170	185
Bonds	500	500,000	....	....	....	....
Franklin	100	1,000,000	....	....	38	42
Mexican Telegraph	....	2,000,000	....	....	180	200
Metropolitan Tel. & Telegraph Co.	....	....	....	....	104	....
Metropolitan Tel. & Telegraph Co. Firsts	....	....	....	....	102½	....
Northwestern Telegraph	....	2,500,000	....	....	104	105
Northwestern Tel 7's	....	.....	..	....	108½	....
Postal Tel. & Cable	..	10,000,000	..	....	80	83
Southern & Atlantic Tel	25	948,775	..	....	78	80
Western Union Tel.	100	94,820,000	93	95⅛	94⅜	94⅝
Real estate bonds	1,000	1,219,000	....	....	....	....
Debenture 7's, 1875-1900	1,000	1,920,000	111	111	112	....
Collateral Trust 5's	1,000	8,181,000	103⅝	103¾	....	....
North American	100	39,767,200	9	9¼	9⅛	9⅜
Brush Ill. Co., common	50	1,000,000	....	....	25	30
Edison El. Ill. of N. Y.	100	6,100,000	120½	126	120	123
" " 1sts	....	....	....	....	117¾	....
" " Deb's	....	....	....	....	....	....
Edison El. Lt. Europe	1,000	2,000,000	....	....	2	6
" Bonds	....	30,000	....	....	80	85
Edison Ore Milling Co.	....	2,000,000	....	....	12	17
East River El. Light	100	1,000,000	....	....	....	65
Fort Wayne Electric	....	.....	....	....	12½	12¾
General Electric	1,000	30,395,600	98	105⅝	98¾	99
Debenture 5's	....	10,000,000	93⅞	97⅛	94½	96
Automatic Exhibition Co.	....	2,500,000	....	....	3	5
Interior Conduit & Ins. Co.	100	1,250,000	61	61	....	....
Mt. Morris Electric	....	500,000	....	....	....	65
N. E. Phonograph	....	2,000,000	....	....	2	4
N. Y. Phonograph	....	2,000,000	....	....	2	5
N. American Phonograph	....	2,000,000	....	....	4½	6
Westinghouse E. & M. Assenting	....	.....	68	68	....	....

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stocks furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.	Electrical Stocks:	Bid.	Ask'd.
Chicago	200		Chicago Arc Light and Power Co.	118	
Central Union	50½		Chicago Edison Co	220	....
Michigan	93				

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, March 11, 1893.

Mr. W. J. Hammer's familiar face was seen at St. Louis during the convention, where he enjoyed a few days rest from professional duties.

P. Klaus & Co., in order to secure better facilities for manufacturing its slow speed incandescent dynamos, has removed its office and factory to 550-552 West Thirty-sixth street, New York City.

The Chas. A. Schieren Company, of New York, attracted a good deal of attention at St. Louis with a 72-inch perforated four-ply leather belt. The company was well represented by Mr. E. P. Atkinson, of the New York office, and Mr. A. W. Harvey, from Chicago.

The Evening Trades School, 225 and 227 East Ninth street, New York City, will hold the last of its course of lectures under the auspices of the Franklin Electrical Society on the evening of March 18, when Mr. W. Wallace Kerr will lecture on "Dynamo Electric Machinery."

The Electric Engineering and Supply Company, of Syracuse, N. Y., at the St. Louis Convention exhibited some of its well known specialties, among which was a handsomely mounted concealed terminal station switch which every one admired. Their flush switch for the conduit system of wiring as well as their porcelain covered branch block and E. E. & S. sockets attracted much attention. The exhibit was in charge of Mr. Goercke.

The Mica Insulator Company filed articles of incorporation March 1, 1893, at Elizabeth, N. J., the authorized capital stock being placed at $100,000, all paid in. The company's plant is located at Schenectady, N. Y., while its office and salesroom will be at 218 Water street, New York City. The officers are: Eugene Munsell, president; Franklin Brooks, vice-president, and Lewis W. Kingsley, secretary and treasurer. The company will manufacture micanite for electrical insulation, a description of which has appeared in these columns. Through a process controlled by this interest, small scrap mica is now utilized in all forms and shapes for insulating purposes where sheet mica was formerly used, at a much reduced cost and with no diminution in efficiency.

Mr. D. Herbert Jeffery, secretary of the Crocker-Wheeler Electric Motor Company, died on the 2d inst., from pneumonia, after a brief illness of ten days. Though Mr. Jeffery was but 41 years of age at the time of his demise, his business career had been a wide and varied one. He was born at Corning, N. Y., and in the early years of the sewing machine business became connected with the Remington and Wheeler & Wilson companies, later turning his attention to the hardware trade with the firm of Sargent & Co. of New York and New Haven. Mr. Jeffery subsequently assisted in the organization of the New York Live Stock Express Company, and was for several years its secretary. This was the first company to build and run cattle cars through from Chicago to New York, in which cattle could be fed, watered and rested without unloading. It was also the first concern to build and run palace horse cars. Mr. Jeffery was also one of the three originators of the large corporation known as the Domestic Spring Bed Company, of Jersey City, N. J., from which he afterwards withdrew, and with his brother established the firm of Jeffrey & Co., Jersey City, manufacturers of wire springs. Foreseeing the great future of the electrical business he subsequently sold out his spring business to accept the secretaryship of the Crocker-Wheeler Electric Company, with whom he has been connected for the past two years. His brief association with the Crocker-Wheeler Company had proved him possessed of great executive ability and a first class salesman, and had endeared him to all of his business associates and the electrical fraternity, with whom he constantly came in contact, doing the major part of the buying and selling for the concern.

Rapid Transit by Extension of the Elevated System.—Another plan for rapid transit in this city was adopted by the Rapid Transit Commissioners at a meeting held on Saturday, March 11, 189'. The main features of the plan are that a third track shall be constructed in each of the thoroughfares traversed by the Second, Third and Ninth avenue lines, two tracks in the Bowery along the route of the Third avenue line, a two-track crosstown connection between the Sixth and Ninth avenue lines through Greenwich avenue, Eighth avenue and Fourteenth street; a two-track crosstown line between the Third and Ninth avenue lines, through 129th street, from Third to Eighth avenue, and the construction of a two track line from the present line at Division street and Park row, near Catharine street, along Catharine or Oliver street or through private property to South street, and through it to Coenties slip, and thence by a route to be fixed upon hereafter to a juncture with the present tracks at or near Whitehall street. All other extensions of the elevated system proposed by the Manhattan company were disapproved. If successfully carried out the scheme will practically result in a belt line elevated system between the Battery and 129th street. The east side lines will also be extended as far north as Fordham. It is provided by the Commissioners that the charge for a continuous trip on the system shall be only five cents. To the company is conceded permission to use steam, electricity or compressed air as motive power. March 15 was fixed for a hearing of the company before the Rapid Transit Commissioners on the new plan. If the plan is approved by the company, specifications regarding the proposed changes must be submitted by May 1 next, and the extension of the system must be completed within two years.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 31, CITY TRUST BUILDING, 927 Chestnut St.,
PHILADELPHIA, Pa., March 11, 1893.

Messrs. Walker & Kepler, 531 Chestnut street, Philadelphia, have accepted the general agency of the Carpenter Electric Heating Manufacturing Company for the sale of its heating specialties and have issued a very neat circular descriptive of the various utensils used for cooking by electricity and full instructions for the use of the same.

The Pentz-Reckenzaun meter, which was displayed at St. Louis by Mr. J. A. Pentz, of Philadelphia, as its name might indicate, is the invention of Messrs. J. P. Pentz and Anthony Reckenzaun and is in the hands of a company at 1001 Chestnut street, Philadelphia, Pa. This meter can be used on either alternating or direct current circuits. It is a gravity meter, simple in construction, accurate in operation, easily transported and can be set up under any conditions.

Thomas Yearsley, dealer in second-hand dynamos and motors, located on the top floor of 123 North Third street, Philadelphia, has formed a copartnership with Mr. Wilson Shinn, the former assuming all outstanding accounts. The firm name will hereafter be known as the Yearsley-Shinn Electric Company. In addition to the second-hand business conducted by Mr. Yearsley for some time past, the new company will manufacture motors and arc dynamos and make a specialty of buying and selling railway machinery. In forming the above partnership and the introduction of a new business it was found necessary to have more room, hence the company has rented the ground floor, which is now being fitted up and will be used as a show and sales room, retaining the top floor for manufacturing purposes. A plant will shortly be installed in the basement. Mr. Yearsley reports business very brisk. One of his large orders recently received was the rewinding of a 1,000-light machine for the Merchants Electric Company of Philadelphia.

The Machine that Talks.—The wonders of the Edison phonograph delighted a good sized and intelligent audience at the Drexel Institute, at the corner of Thirty-second and Chestnut streets, Philadelphia, on the 9th inst., when Mr. Milton F. Adams, of New York, gave an exhibition of Mr. Edison's most recent improved machine. The phonograph used on this occasion was not unlike in appearance to that of a tin horn mouthpiece, which intensified and disseminated the sounds, so that every little phase and articulation of the wonderful reproduction were heard with great distinctness in almost the remotest portion of the auditorium. The little gelatine cylinders bearing the impression of the sounds to be reproduced were placed in position on the axis of the machine, which was then set in revolution by a small electric dynamo, and the sounds issued from the funnel-like mouthpiece. Some very extraordinary results were exhibited, reproductions of vocal and instrumental music, complete orchestra pieces, like the overture to "William Tell" played by Gilmore's Band, and selections by the Marine Band were heard with great distinctness; also the reproduction of banjo, cornet and xylophone solos; whistling and recitations were equally well presented. The great practical utility of the phonograph to the business man as a handy means of dictation in correspondence and other matters was also demonstrated.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., March 11, 1893.

Mr. D. A. Andrews, of the Pettingell-Andrews Company, died at Washington on the 11th inst. of rheumatic fever.

The New Haven Electrical Company has increased its capital from $300,000 to $400,000. The increase has been paid in cash.

The annual meeting of the stockholders of the General Electric Company will be held at Schenectady, N. Y., on Tuesday, April 11.

The firm name of Locke Bros. has been changed to that of "The Locke Regulator Company." The company consists of N. C. Locke, A. N. Locke and Mark C. Felch.

The Davidson Ventilating Fan Company has removed to new quarters at the corner of Milk and Oliver street. It is also the Boston agent for Case automatic engines.

The hearing on the temporary injunction restraining the Perkins Lamp Manufacturing Company, of Manchester, Mass., from continuing business will be heard at Hartford this month.

The Wheelock Engine Company, of Worcester, Mass., is building several large compound engines averaging around 800 h. p. The growth of its business has been very steady and satisfactory.

Mr. Harry P. Bishop, representing the Massachusett Chemical Company, succeeded in impressing every one at the recent St. Louis Convention with the fact that "Insullac" is unexcelled as an insulator.

The Jarvis Engineering Company has been awarded a silver medal for its American feed water heater by the Mechanics' Charitable Association. The same association awarded this company a bronze medal for its grate shaker.

The West End Street Railway Company, Boston, Mass.—In an action of damages brought against the above-named company by Mr. W. H. Howard, a verdict for $16,000 was rendered for the plaintiff; damages claimed were $30,000.

The Samson Cordage Company, Boston, Mass., manufacturers of braided cordage, used principally for winding the fields of dynamos and for guiding the trolley, and for signal purposes, reports business as being very satisfactory.

The Boston Incandescant Lamp Company, of Boston, Mass., brought its new series lamp prominently before all those attending the recent convention at St. Louis. The large experience of this company has enabled it to bring its lamp to a high state of perfection. Mr. M. Merritt looked out for the interest of the company.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, March 11, 1893.

The Chas. E. Gregory Company, of Chicago, made a very effective display at St. Louis with its "Acorn" weather-proof switch, insulated arc lamp hanger and other specialties.

The Central Electric Company have just placed upon the market a hard rubber hydrometer, which is pronounced to be superior to the old form glass hydrometer.

Treasurer Hall, of the C. & C. Electric Motor Company, was an active representative of the company at St. Louis, while its Western interests were looked out for by Mr. H. Wilson.

The largest traveling derrick ever raised for practical use or experimental purposes is the one which will be used in placing in position the steel roof of the Mackaye Spectatorium, at Chicago. This derrick weighs nearly 70 tons, is 180 feet high, and will be capable of lifting the 1,000 tons of steel which will be used in the roof of this building.

Mr. W. D. Packard, of the New York & Ohio Company, well known for his connection with the celebrated Packard lamps, was conspicuous at the National Electric Light Association at St. Louis.

Mr. J. C. Tierez, representing the Goodrich Hard Rubber Company, of Akron, O., impressed it upon the minds of all who attended the St. Louis Convention that hard rubber in a great variety of forms is an important factor in all electrical work, and that the Goodrich company, in appreciation of this fact, has paid special attention to the variety and excellence of its products.

The Cutter Electrical and Manufacturing Company had an excellent exhibit at the recent convention at St. Louis of its specialties in its parlors, including its well known flush switches, push button switches, flexible brackets and new commutation switch, which were under the charge of Mr. H. B. Cutter in person.

E. F. Seixas, who is connected with the Chicago & St. Louis Electric Railroad, has just returned from an extended trip through Missouri and Kansas, and finds the greatest amount of enthusiasm over the proposed road. The Westerners are looking forward with delight to the accomplishment of this undertaking, as it will prove to them the possibility of connecting a great many of their cities by an electric railway.

George Cutter, 329 The Rookery, Chicago, Ill., has issued a most attractive little catalogue describing the well known specialties which he handles, including Cutter's insulators, street hoods, shades, waterproof key sockets, non-inductive ammeters and voltmeters, switches, lightning arresters, cut-outs, etc. A number of interesting sketches lighten up this solid array of descriptive matter.

The Great Western Manufacturing Company, of Chicago, is making arrangements to install machinery and furnaces for drawing wire in its Duluth works. The capacity designed at present is 20,000 pounds per day. It is expected that this will be in working order by the first of September. The Sycamore wire factory of the Great Western Manufacturing Company is pushed to its utmost capacity in the manufacture of its well known weatherproof and magnet wires, and for the last two months has been running night and day.

The Central Electric Company, of Chicago, desire to advise the trade that they have for distribution monthly the *Architect's Bulletin*, published by the Interior Conduit and Insulation Company, giving a brief description of the principal buildings in the country in which the complete system of conduiting and Okonite wire has been placed during the previous month. They will be pleased to mail one of these copies to any one sending their card and will place them upon the regular list and forward them a copy of the bulletin each month free of charge. This will no doubt prove of interest and profit to contractors and central station men, as the Interior Conduit Company is constantly putting new and improved devices upon the market.

News of the Week.

THE ELECTRIC LIGHT.

Anthony, Kan., is to have electric lights.

Mexia, Tex., will light its streets by electricity.

The Electric Plant at Eureka is nearing completion.

Rock Rapids, Ia., is making a move for electric lights.

Georgetown, Tex., has under consideration electric illumination.

The Seguin (Tex.) Electric Light Plant is partly completed.

Arcadia, O., is discussing the question of electric lights for its streets.

Wenatchee, Ore., is taking steps to light its streets by electricity.

Fargo, N. D.—The City Council has passed an ordinance granting a franchise for the new electric light company, which promises to reduce the present rates about 30 per cent., and also to build an electric railroad between Fargo and Moorhead.

The Hagerstown (Md.) Board of Street Commissioners has advertised for proposals for lighting the streets of the city with arc lamps for a term of from three to five years. Bids will be received until April 3, 1893.

The Oyster Bay (L. I.) Board of Highway Commissioners has granted to Curtis & Bean, of New York City, the privilege of erecting and maintaining poles for the stringing of wires and cables to transmit the electric wires over highways, roads and streets of the villages of Glen Cove, Glen Head, Locust Valley and intermediate places.

THE ELECTRIC RAILWAY.

The Covington Street Railway Company is changing the equipment of its 12 miles of road from the double trolley to the single trolley system.

The Boston & Maine Railroad, it is rumored, will experiment with an electric locomotive on its Crescent Beach branch to haul freight and passenger cars over that line.

The Whatcom (Wash.) City Council has passed a franchise to the Lyndon Electric Railroad Motor Company for a right of way for the construction of its line through the city to the water front.

Part of the York Road line of the City & Suburban Railway will be put in operation in a few days, power being temporarily supplied by the Central Railway. The rest of the line will be opened May 1

The Dartmouth & Westport (Mass.) Street Railway Company has secured the location for its tracks in Dartmouth. This road is practically a creation of the Union Street Railway, of New Bedford, and the Globe Street Railway Company, of Fall River.

The La Bolteaux Electric Motor and Fan Company, Cincinnati, O., has about completed the insulation of an electric car to run on an elevated track in the dry-goods store of Adams & Dolpke to convey parcels to the wrapping clerk, thus doing away with a number of cash boys.

The Marion (Ind.) Street Railway Company will this spring extend its line south from the Soldiers' Home to Gas City and Jonesboro, a distance of about four miles, and north over a mile from the present terminus in North Marion to the Philmatter Park. Six new closed cars will be ordered and open cars placed upon all the lines.

At the last meeting of the Baltimore City Council an ordinance was submitted authorizing President George Blackiston, of the Central Railway, and others, to construct railway tracks and propel cars by electricity along certain streets in the eastern section of the city. The new line will connect with the Central Railway at Lombard and Caroline streets.

PERSONAL NOTES.

Col. Taylor, an old-time telegrapher, died last week at Louisville, Ky.

Mr. Alfred E. Kornfeld, recently with the *Electrical Age*, has entered upon the duties of New York representative of the *Street Railway Gazette*, of Chicago.

Mr. Nelson W. Perry's friends will sympathize with him in his bereavement in the death of his father, which occurred at Cincinnati, O., on the 11th inst.

The many friends that Mr. Max Luhn, of the Helios Company, of Cologne-Ehrenfelt, Germany, made during his recent visit to the United States, will be pleased to learn that he has been appointed chief electrical engineer of the Helios Company and intrusted with the management of its Berlin office.

Mr. W. S. Andrews has resigned his position of general superintendent of the works of the Canadian General Electric Company, Limited, at Peterborough, Ont., to assume the management of several large electric light and power concerns in Pennsylvania. His experience in this business dates from 1883, when, in connection with Mr. Frank J. Sprague, he put in the first Edison three-wire central station plant at Sunbury, Pa., and since that time a great number of Edison light stations have been installed and started under his supervision, among which may be mentioned Harrisburg, Williamsport and Lancaster, Pa.; Rochester, N.Y.; New Orleans, La.; Chicago, Ill., and Minneapolis, Minn.

MISCELLANEOUS NOTES.

Messrs. W. S. Horry and W. F. Smith looked well to the interest of the Heisler Electric Company at St. Louis This company is now at work on some new alternators for which many excellent qualities are claimed.

A second tunnel at Niagara Falls is now contemplated, it being evident that the capacity of the present tunnel will ultimately be entirely inadequate to supply the demand for power, a very large portion of which will be transmitted to Buffalo.

Mr. E. L. Babcock, president of the Falls Rivet and Machine Company, and his son Charles brought to the attention of their many friends at the St. Louis Convention the merits of their admirable clutches, and even carried away a number of handsome contracts.

Flint, Mich.—A telephone company is projected by J. H. McFarland, Dr. O. Millard and G. L. Smith. It is proposed to manufacture the instruments in Flint and to offer a service which shall not cost subscribers over $18 per year for house service and $24 for business places, against the present high rates of the Bell company.

Mr. J. W. Godfrey, from New York, and Mr. E. Rugel, of St. Louis, representing the New York Insulated Wire Company, distributed at the convention some attractive little souvenir pocket-books which were in great demand.

The "Deadly Wire" Saves a Life.—During the conflagration at Boston, last week, Chief Egan, of the Fire Department, found himself on the top of a burning building cut off from any means of escape. He saved his life by crawling out on one of the so-called "deadly electric cables," where he remained suspended until a ladder was pushed up for his rescue.

A Correction.—Mr. W. J. Hammer in a recent communication calls attention to several errors in the official report of the proceedings of the National Electric Light Association at St. Louis. On page 181 of THE ELECTRICAL WORLD he is made to quote Dr. Bell as having stated that "It is not practicable to use multiphase machines over 1,200 volts." He referred to direct current machines, not multiphase, and called attention to the fact that Prof. Crocker had made the statement before the American Institute of Electrical Engineers that he had been running for some time direct current machines of 5,000 and 6,000 volts without any trouble whatever and was now constructing one of 10,000. Further on in the same paragraph he is quoted as follows: "I do not think Dr. Bell placed enough importance upon the application of the transformer in this country." This should read "the direct current transformer, or motor transformer." On page 176, in his remarks upon the relative life of incandescent lamps upon continuous and alternating current circuits, he is made to state that "It is a well-known fact that an incandescent lamp will last longer at a lower rate than at a higher rate of alternation." The expression he used was "That it is a well-known fact that an incandescent lamp would last longer at a low electromotive force than at a high one."

Industrial and Trade Notes.

Mr. H. T. Paiste received many compliments at the St. Louis Convention on his various specialties.

Mr. M. M. Hayden, of the Law Battery Company, 85 John street, reports large orders for batteries, cells, etc.

Mr. J. F. Kester represented the Kester-Atwood Electric Company, of Chicago, at St. Louis. This company manufactures the well known Kester arc lamp.

Carpenter rheostats and Carpenter enamel specialties are now to be found almost everywhere, and an illustration of their popularity is the attention they attracted at the St. Louis convention.

The Jenney Electric Motor Company was well represented at St. Louis by Mr. Chas. D. Jenney, who is well known to the electrical fraternity as are also the motors which this company manufactures.

Wm. C. Callmann, 591 Broadway, New York, agent for the Feldkamp Electric Wire Company, of Newark, N. J., sold last week 100 of the Feldkamp electric ceiling fans to a large Philadelphia supply house.

Mr. E. G. Bernard, of Troy, N. Y., exhibited at St. Louis the Powers arc light cut-out and the new safety porcelain cleat manufactured by the E. G. Bernard Company, which were the cause of much favorable comment.

Mr. Geo. A. Hill, manager of the Typewriter Exchange, 10 Barclay street, reports large and increasing orders for typewriters of different makes. Mr. Hill makes a specialty of selling typewriters of any manufacture.

The Card Electric Motor and Dynamo Company was represented at the National Electric Light Association by its president, J. W. Wilshire, who reported that the business prospects of the company were most flattering.

Messrs. Shippey Bros., 13 and 14 King street, Cheapside, London, England, are the European agents for the Law Battery Company's products, and to them was shipped Monday last a large consignment of cells, electro-therapeutical supplies, etc.

The J. T. Case Engine Company, in the attractive little folder recently sent out by it, describes the good points of the various kinds of steam engines manufactured, and not gas engines, as erroneously stated in THE ELECTRICAL WORLD of March 11, 1893.

One of the interesting exhibits at the St. Louis Convention was a C. & C. motor and generator furnishing current for the exhibit of the Electric Selector and Signal Company. Mr. E. V. Matlack, of the Laclede Power Company, St. Louis, was in charge of this exhibit.

The Frasse Company is the firm name of the new company which has bought out the business interests of Frasse & Co., 90 to 94 Park Row, New York City. After May 1 the new company will seek larger and more convenient quarters at No. 19 Warren street, near Broadway.

The Consolidated Electric Manufacturing Company, 355 Congress Street, Boston, Mr. Chas. E. Bibber, general manager, is presenting its friends with a neat celluloid whist marker that calls attention to the Lyon brake handle and other specialties of its manufacture.

The Nowotny Electric Company, Cincinnati, O., is meeting with marked success in the new line it has taken up, and reports sales in February of two 300-light incandescent dynamos, three steamboat electric light plants, besides a number of orders for arc amps, motors, etc.

The Foster Engineering Company, Newark, N. J., is reminding its friends by an attractive catalogue that it is the manufacturer of the well known Foster standard pressure regulators and reducing valves, steam fitting for cars, McDowell safety valve, automatic pump governors and a variety of other apparatus in this line.

The Joseph Dixon Crucible Company, of Jersey City, N. J., has finally been awarded space at the Columbian Exposition—a space 25 × 28 feet in the Mines Building, for a general exhibit of its graphite productions. A space 13 × 19 feet was also obtained in the Manufactures Building for the exhibition of Dixon's American graphite pencils, etc.

The Utica Electrical Manufacturing and Supply Company, of Utica, N. Y., is sending out an attractive catalogue in which its Hercules switch, double-pole and single-pole knife switches, automatic magazine fuse boxes, simplex and duplex lighting arresters, mast arms and other specialties are fully described and illustrated, while an excellent set of tables, wire gauges, etc., occupy the last ten pages.

Messrs. James Schauel & Co. report the year 1892 as a most successful one and that the new year has opened very auspiciously. This firm furnishes pure soft platinum sheet and wire in various forms and sizes, making a specialty of supplying the lamp trade, as well as manufactures bells, electrical instruments, etc. It also takes in exchange platinum scrap for metal, and platinum taken from incandescent lamps, instruments, etc., remelts platinum scrap, etc.

Rossiter MacGovern & Co. is the title of a new firm which has recently opened offices at 39 Cortlandt street, this city. The firm is composed of Messrs. F. MacGovern and V. Rossiter, and a general business will be conducted in dealing in second-hand electrical apparatus, machinery, engines, boilers, etc., and installing of plants. Their announcement appears in this issue of THE ELECTRICAL WORLD and may prove of interest to intending purchasers of apparatus and supplies.

The Laidlaw-Dunn-Gordon Company is the name of the new company which has been formed by the consolidation of the Laidlaw & Dunn Company, of Cincinnati, O., and the Gordon Pump Company, of Hamilton, O. The new company, with a capital stock of $700,000, will erect in Cincinnati or its immediate vicinity, in the near future, one of the largest and best equipped pump and hydraulic works in the United States. The directors of the new company will be Robert Laidlaw, Walter Laidlaw, John W. Dunn, Thomas McDougall, Alexander Gordon, Robert McKinney, Thomas J. Gaff. The officers of the company will be Robert Laidlaw, president; Walter Laidlaw, vice-president and general manager, and John W. Dunn, secretary and treasurer.

The Berlin Iron Bridge Company, of East Berlin, Conn., has secured the contract for the new buildings required by Wm. Cramp & Sons' Ship and Engine Building Company, Philadelphia, Pa. The Berlin Bridge Company has lately completed a boiler shop for the Cramps, and now has a contract for all the other buildings required to enlarge their plant. The new buildings will consist of a ship shed 60 feet by 100 feet, a blackboard 75 feet by 200 feet, and a bending shed 86 feet by 150, constructed throughout of iron. The Berlin Iron Bridge Company has also just completed a power station 38 feet wide by 112 feet long for the Roaring Fork Electric Light and Power Company, at Aspen, Colo.

The Purity Oil Filter Manufacturing Company, Pittsburgh, Pa., reports that its business for last month had been larger than any one month in its experience, which is certainly very gratifying. The following are some of the orders for February: The Bridgeport Copper Company, Bridgeport, Conn., one large Ideal steam oil filter; Du Bois Electric Light Company, Pennsylvania, one filter; Alleghany County Court House, one filter, which was its fifth order for oil refiners; Buckingham & Hecht, San Francisco, Cal., one filter; The Holly Milling Company, Holly, Mich., one filter; Southwest Connellsville Coke Company, Connellsville, Pa., one filter; Deer Park Electric Light and Power Company, Port Jervis, N. Y., one filter; Camden Horse Railway Company, Camden, N. J., one filter; Elkton Electric Light and Power Company, Elkton, Md., one filter. The Union Railway Company, Chester, Pa., has also ordered one filter, and many others.

The Ansonia (Conn.) Electric Company, formerly the Electrical Supply Company, of Chicago, has lately been installing considerable apparatus in some of the new World's Fair hotels One of its latest orders is for a 250 number Ansonia gravity needle annunciator, and some of the largest hotels in the city are running all their electric bells and alarms with a Diamond carbon battery. This company has also recently received a letter in reference to its insulated wires and cables, of which the following is an extract: "We average from 3,300 to 4 000 volts on our circuits, and during the entire period of our use of Habirshaw insulation we have never had a single burn-out, or ground, on any of our underground circuits, many of which are constantly immersed in water; in fact, our underground service has given greater satisfaction than we had expected, and we have every reason to attribute it to the superior quality of the Habirshaw cables which we use. As an evidence of our experience with your cables we have placed an order for immediate shipment for five miles more of the Habirshaw cables for underground work, some of which will displace other cables."

J. W. Parker & Company, agents for the Ball Engine Company, 38 South Fourth street, Philadelphia, are congratulating themselves upon the increased demand for the Ball engine, and the sales and orders recently received, which, together with construction work accompanying them, will keep the company busy until next June. Some of the most important orders are as follows: Oxford Electric Light and Power Company, Oxford, Pa., one 13 by 12 100-h. p. engine; Milton Electric Light Company, Milton, Pa., one 13 by 12 100-h. p. engine; Bloomsburg Electric Light Company, Bloomsburg, Pa., one 13 by 12 100-h. p. engine; Doylestown Electric Light and Power Company, Doylestown, Pa., one 13 by 12 100-h. p. engine; Rufe Bros., Doylestown, Pa., one 8 by 10 30-h. p. engine; Blakeley & Dickson Traction Street Railway Company, Scranton, Pa., two 20 by 18 300-h. p. railway engines, and four 72 by 20 150-h. p. boilers, and erection of complete power station; Tampa Street Railway Company, Tampa, Fla., one 12 by 20 cross-compound railway engine; Campbell Creek Coal Company, Maldin, West Va., one 12 by 12 engine and boiler; Elkton Electric Light Company, Elkton, Md., one 12 by 12 engine and boiler. J. W. Parker & Company are on the eve of taking larger and more commodious storerooms which they will fit up in less than a month to properly handle the large increase in their business.

The Ball Engine Company, Erie, Pa., has made some unusually large shipments for this time of year, and reports that it is crowded with orders. The following are some of the recent shipments: L. M. Rumsey Manufacturing Company, St. Louis, Mo., two 35-h. p. engines; Midvale Steel Company, Nicetown, Pa., one 130 h. p. engine; General Electric Company, Tucson, Ariz., one 130-h. p. engine; Lakewood Casino Company, Lakewood, N. J., one 50-h. p. steam plant: Calumet Street Railway Company, Chicago, Ill., four 300-h. p. cross compounds; Wheeling Street Railway Company, Wheeling, W. Va., three 250-cross compounds; Western Light and Power Company, Chicago, Ill., one 360-h. h. engine; Risdon Iron Works, San Francisco, Cal., three 150-h. p. tandem engines; Cienfuegos, Cuba, one 60-h. p. engine; Nantasket Steamboat Company, Boston, Mass., three 25-h. p. engines and one 35-h. p. engine; Griggsville Electric Company, Griggsville, Ill., one 50-h. p. steam plant; Frank Jones Building, Cincinnati, O., one 35-h. p. engine; Hahane & Co., Newark, N. J., one 35-h. p. engine; Hammond Electric Railway Company, Hammond, Ind., one 150-h. p. steam plant; Logansport Electric Light Company, Logansport, Ind., one 130-h. p. engine; Combination Mining and Milling Company, Philipsburg, Mont., two 35-h. p. engines; Doylestown Electric Light Company, Doylestown, Pa., one 100 h. p. engine; Macon & Indian Springs Railway Company, Macon, Ga., one 150-h. p. steam plant; Dayton Manufacturing Company, Dayton, O., one 100 h. p. engine; Cooley & Vater, Duluth, Minn., one 80-h. p. engine; Seabury & Johnson, East Orange, N. J., one 25-h. p. engine; Produce Exchange, New York City, one 25-h. p. engine; Edison Electric Illuminating Company, Mt. Carmel, Pa., one 100-h. p. engine.

Over 5,000 h. p. Harrisburg Ide and Ideal Engines Sold in One Month.—W. R. Fleming & Co., of New York and Boston, representing the Harrisburg Foundry Machine Works, report that they have closed in the past few weeks the following contracts: Two tandem compound Ideal railway engines, 1,000 h. p., for the Electrical Association, Boston, Mass.; two tandem compound Ideal railway engines, 1,000 h. p., for the Montreal Street Railway Company, Montreal, Que.; one tandem compound Ideal engine, 500 h. p., Taunton Electric Light Company, Taunton Mass.; two Ideal railway engines, 400 h. p., including boilers with Weitmeyer settings and complete installation of power plant, for Lancaster & Columbia Railroad Company, Lancaster, Pa.; two simple Ideal engines, 375 h. p., for Jos. Edwards & Co., New York,

N. Y.; two Ide engines, 200 h. p., for direct coupled lighting work in the Houston street station, and two Ideal engines, 175 h. p., for electric light service in the Fiftieth street station for the Broadway & Seventh Avenue Railroad, New York, N. Y.; two Ideal engines, 150 h. p., for the Stewart Building, New York, N. Y.; two Ideal engines, 75 h. p., for the *Mail and Express* Building, New York, N. Y.; one Ideal engine, 75 h. p., Meyenberg Corporation, Hoboken, N. J.; one Ideal engine, 60 h. p., General Electric Company, Boston, Mass. In addition to the above the Harrisburg Works are busy on contracts they have closed in the territory not controlled by W. R. Fleming & Co., among which are the following: Three Ideal tandem compound engines, 3,000 h. p., including boilers, Weitmeyer settings, and complete installation of power plant, for Irwin Electric Light and Power Company, Irwin, Pa.; one 125 h. p. Ideal tandem compound engine and boiler, with Weitmeyer setting, including erection of complete power plant, at Phœnixville, for the Eastern Engineering and Construction Company, of Philadelphia, Pa.; one 80 h. p. Ideal engine for DuBois & Van Tassell, DuBois, Pa.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Oil Filters for sale cheap. Prices on application to Purity Oil Filter Manufacturing Company, 901 Water street, Pittsburgh, Pa.

Battery Cut-out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Johnston's Electrical and Street Railway Directory.—What others say of it:

"We are very much pleased with same."—Eureka Tempered Copper Company, North East, Pa.

"A welcome addition to our library."—Sioux City Electrical Supply Company, Sioux City, Ia.

"Allow us to congratulate you on the success of your work."—Metropolitan Railway Company, San Francisco.

"A very complete and useful book."—Detroit Electrical Works, Detroit, Mich.

"We shall treat it as a valuable addition to our library."—The United States Corporation Bureau, Chicago.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED MARCH 7, 1893.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

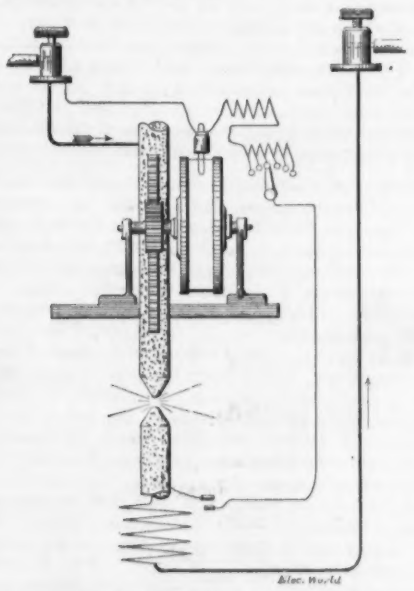
422,277. Design for a Frame for Electric Motors; Alexander W. Meston, St. Louis, Mo. Application filed Aug. 30, 1892. The design consists, essentially, in a cylindrical shaped casing for electric motors mounted upon a tripod base.

492,773. Electro-Magnetic Brake; Andrus D. Ayres, Kalamazoo, Mich. Application filed Dec. 21, 1891. In an electric brake, in combination with a revolving element, a series of electromagnets and a series of incasing armatures, one of the series being firmly fixed to the revolving element and the other series to an independent support, with means for energizing the series of magnets where, by an application of the current, the revolving element is interrupted.

492,786. Automatic Electric Switch; Andrew M. Coyle, Baltimore, Md. Application filed Feb. 18, 1892. The combination of an electric circuit, a series of resistances having their terminals connected with fixed contact plates, a solenoid having several independent coils connected in series with these resistances, and having also a coil connected in a separate circuit, and a contact spring or brush carried by the core of the solenoid, and adapted when the core is attracted to make contact successively with the contact plates, thereby cutting out the resistances and also the coils of the solenoid connected therewith.

492,807. Automatic Circuit-Breaker; Delos Irish and John G. Williams, Salt Lake City, Utah. Application filed Sept. 14, 1892. In a circuit breaker, the combination of an electromagnet arranged in the working circuit, a weighted drop armature arranged at one end of the magnet, a stationary contact arranged in the magnet circuit, and a movable spring supported contact adapted to be held normally out of contact with the stationary contact and controlled by the drop armature.

492,808. Adjustable Lamp Hanger; Nicholas Jenkins, Waterbury, Conn. Application filed April 19, 1890. The combination with the two part case, of the standards fastened to one of the parts, the arbor with squared ends engaging corresponding openings in the standards, nuts on the arbor, the windlass loose on this arbor and a brake spring interposed between one of the nuts and the end of the windlass.



No. 492,815.—Electric Arc Lamp.

492,809. Incandescent Lamp; John von der Kammer, Chicago, Ill. Application filed Jan. 23, 1893. In an incandescent lamp the combination of a filament and conductors with a receiver, or bulb, whose walls are composed in part of glass and part of metal, with the glass portions fused on the metal substantially at right angle thereto and on the outer surface only of the metal part.

492,811. Wire Connector; Wm. S. Kisinger, Bellevue, Ky. Application filed Sept. 9, 1892. The combination, in a coupling for wires, etc., of a tube having converging ends, and a set of bodily detachable keys whose outer edges are tapered and their inner edges provided with teeth.

492,815. Electric Arc Lamp; Carl K. MacFadden, Chicago, Ill. Application filed Aug. 12, 1892. In arc lamps a solenoid, having a movable core in line with and concentric with the lower carbon, and dash pot whose piston is attached directly to the movable core of the solenoid and concentric with the carbon and core. (See illustration.)

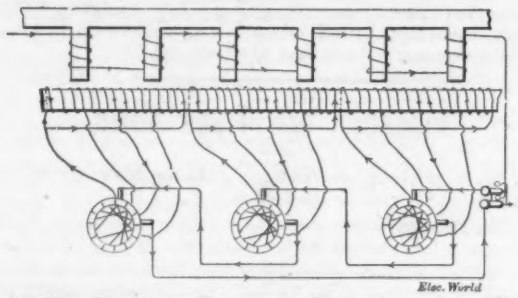
492,837. Apparatus for Automatically Stopping Railway Trains; Edward W. Robinson, Boston, Mass. Application filed July 13, 1891. The combination with the track rail of two conductors extending on either side of the rail and parallel with same, each of the conductors being disconnected or broken at intervals, and with the breaks of the other conductor, and the broken conductors having normally no electric connection with each other, and cross pieces of conducting material extending between the rail and broken conductors without normally connecting the same.

492,847. Balanced Electric Drop Light Hanger; Truman E Stevens, Blair, Neb. Application filed June 21, 1892. The object of this invention is to make a perfect balance between the weight of the light and the tension of a coil spring supporting the same, also to simplify the mode of completing the electric circuit through the suspending apparatus.

492,850. Combined Indicating Electric Switch and Current Reverser; Almon B. Strowger and Walter S. Strowger, Chicago, Ill. Application filed Feb. 19, 1892. A combined indicator switch and current reverser consisting of an indicator, a series of pairs of contact heads, the heads of each pair being adapted to be connected with the opposite poles of a battery, and a switch movable over the heads and adapted to be brought into contact therewith and provided with means for reversing the current.

492,866. Automatic Electric Sprinkler and Alarm; Charles S. Hurd, Cleveland, O. Application filed April 13, 1892. This invention consists of a chamber perforated at the top and provided with a circular deflector, centrally supported above the perforations and directing flange, a stud extending vertically above the deflector and secured thereto, this stud being separated into two portions connected by fusible solder, a nut on the extremity of the stud and a bell covering this deflector and perforation, with packing between the bell and deflector, and a spring between the nut and bell.

492,881. Leading-Piece for Overhead Electric Railways; Henry D. Winton, Wellesley, Mass. Application filed June 20, 1892. This invention consists mainly in independent leading pieces which can be strapped or bolted to an electric trolley wire so that it will clamp on plates and discs in such a manner that the trolley wheel will be directed on these plates and discs and diverted from one wire by another, so that lines running in opposite directions may be crossed easily, or the wheel may be switched from one wire to another.



Elec. World

No. 492,888.—Dynamo Electric Machine and Motor.

492,883. Telephone Transmitter; Charles T. Bloomer, New York. Application filed Dec. 14, 1892. This invention consists of the combination of a vibrating diaphragm and a variable resistance connected therewith and included in the circuit, which resistance consists of a mass of powdered carbon with one or more strips or ribbons imbedded therein.

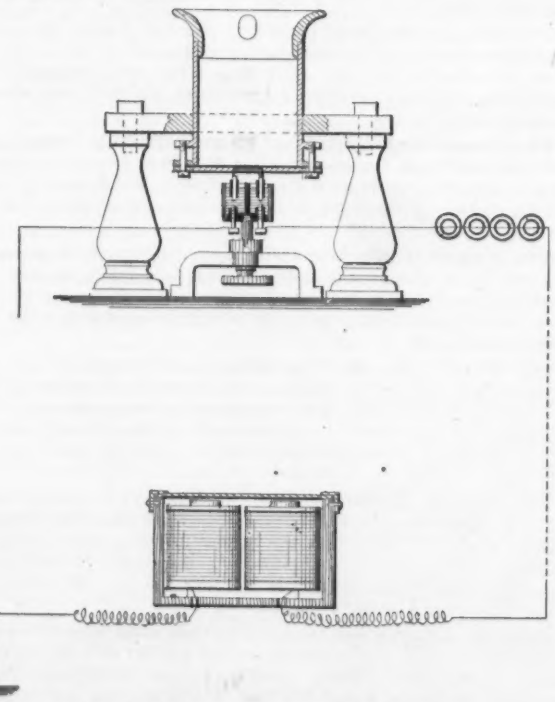
492,888. Dynamo-Electric Machine and Motor; R. H. Hunter, Philadelphia, Pa. Application filed Oct. 29, 1892. The combination of a series of pole pieces of alternate polarity arranged in a circle, a rotating armature having independent closed wire coils connected to separate commutators arranged on the same side of the armature, a series of brushes for the commutators, and connecting circuits for coupling the brushes of the several commutators in series. (See illustration.)

492,913. Electric Lamp-Lighter; Josephus C. Chambers, Detroit, Mich. Application filed Nov. 21, 1892. In an electrical lamp-lighter, the combination, with a lamp, the burner of which is formed into or provided with an electrode, an extinguisher formed into or provided with the opposite electrode, and means for establishing and breaking the electrical connection between the electrodes.

492,971. Electric Programme Clock; Andrew J. Reams, Wichita, Kan. Application filed Aug. 3, 1891. In the electric programme clock, the combination of the main lines and battery thereof; the relay connected in parallel with said main lines; the electromagnet electrically connected with the relay; the frame supporting the electromagnet; the lever pivotally supported by the frame and carrying at one end the magnet armature, and at its opposite end the pawl, held upright to its work by a spring; the ratchet wheel carried on the hand arbor, supported by the frame, and adapted to be engaged by the pawl; and the retractile spring arranged and connecting the lever.

493,000. Electric Steering-Gear; Lewis S. Van Duzer, U. S. N. Application filed Nov. 26, 1892. An apparatus for vessels having an electromotive device for regulating the application of power to the tiller, a switch for regulating the direction of the applied power and a steering handle or lever having circuit connections with the switch for regulating its movement. (See illustration.)

493,007. Secondary-Battery Electrode; Isaac H. Bartholomew, Northford, Conn. Application filed May 31, 1892. This consists of a group of lead tubes, inwardly upset from their outer surfaces to form inwardly projecting retaining points or burrs, and tubular linings of active material, for the respective tubes in which they are held in place by these burrs or retaining points, each tube having when completed a central circular opening extending throughout its length.



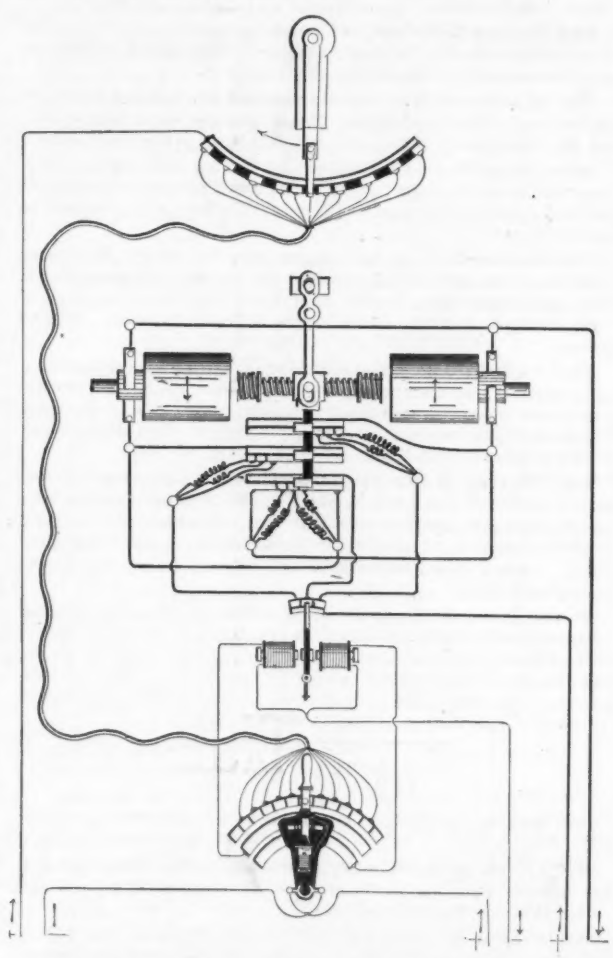
No. 492,789.—Speaking Telegraph.

493,009. Automatic Switch; Charles H. Bedell, Swarthmore, Pa. Application filed June 25, 1892. The combination of an electric circuit, circuit breaking points in this circuit; a lever having circuit closing points in position to complete the circuit, a holding lever having at its free end a roller arranged in position to engage the free end of the said circuit breaking lever, an electromagnet in the protected circuit, and an armature therefor in position to trip or move the holding lever and thus release the circuit closing lever upon an increase in the strength of current in the protected circuit.

493,025. Armature for Electric Motors; Robert H. Hassler, Dayton, O. Application filed Aug. 15, 1892. An armature core, having its magnetic material forming an annular band or ring, leaving an interior cylindrical cavity running the entire length of the armature, in combination with coils placed upon the core in such a way that the interior cavity will be occupied and approximately filled by the flanks of the coils, these coils passing into and out of the cavity at the same end of the armature.

493,030. Combined Cigar Cutter and Electric Lighter; Abel Huot, New York, N. Y. Application filed June 22, 1892. The combination with a cigar cutter having and operating handle to actuate one of the cutter blades of a gas supply pipe provided with a cut-off, intermediate mechanism between the handle and gas cut off, whereby the former actuates the latter, a burner connected with said gas pipe, and an electric circuit having one of its terminals at said burner, and the other carried by the operating handle, and in position to make and break circuit with the other terminal when the handle is operated.

493,067. Hotel Time-Annunciator; Franklin S. Carter Burlington, N. J. Application filed Aug. 15, 1892. This consists of an electrical circuit, including call bell located in a guest's room, a circuit-closing arm attached to the hour hand shaft of a time mechanism, a series of short sections of conductors, each normally open at two points under the control of a contact arm and a rotary switch respectively, with a return call circuit normally open in the guest's room and including a battery, an annunciator bell at the office, and a point or stud for closing the circuit to its respective bell at any time.



No. 493,000.—Electric Steering Gear.

492,789. Speaking Telegraph; Thomas A. Edison, Menlo Park, N. J. In a telegraphic instrument operated by sound, employing a conducting fluid as a part of the circuit, the combination with the diaphragm of an electrode immersed in the liquid and insulated except at its extreme end. (See illustration.)

493,104. Dynamo-Electric Machine; William Morris Mordey, London, England. Application filed April 28, 1891. In a dynamo-electric machine, an armature comprising a supporting frame and a series of laterally detachable and radially adjustable armature coils secured near their outer ends to the frame.

493,109. Incandescent Lamp Socket; James F. McLaughlin, Philadelphia, Pa. Application filed Sept. 13, 1892. A light regulating socket for incandescent electric lamps, having an incomplete carbon ring housed within the socket, and provided with an insulating portion projecting beyond the periphery of the ring, and a brush bearing upon the carbon ring in the path of the insulating block.

493,125. Electric Railroad Danger Signal and Bell; Paul Seiler, San Francisco, Cal. Application filed July 13, 1892. A trolley wire, the suspension piece to which the trolley wire is fixed, a stud extending vertically upward the suspension piece, an insulated guide within which the stud is movable, and an elastic arm with which the stud is brought into contact by the passage of the trolley beneath the suspension piece, and wires leading from the arm to the signal mechanism which is actuated thereby.

493,212. Trolley Wire Support; Frank E. Head, Toledo, O. Application filed June 13, 1892. The combination with a U-shaped hanger of a clamping piece arranged therein, an adjusting collar or nut, an insulator block, and a bolt connecting the block and adjustable collar or nut.

493,221. Apparatus for Transferring Secondary Batteries; Mathias Pfatischer, Philadelphia, Pa. Application filed July 22, 1892. In a charging table a series of parallel tracks or ways and a series of troughs or trays each containing a number of cells of secondary battery; a cogged rack attached to each trough or tray; cogged wheels located on the charging table in position to engage with the racks; means suitable for rotating the wheels to move the troughs or trays and a suitable device for disengaging the rack on any trough from its cogged wheel.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.

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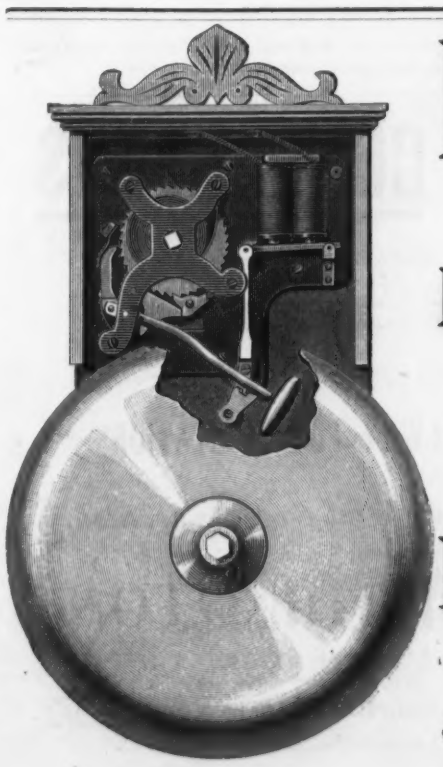

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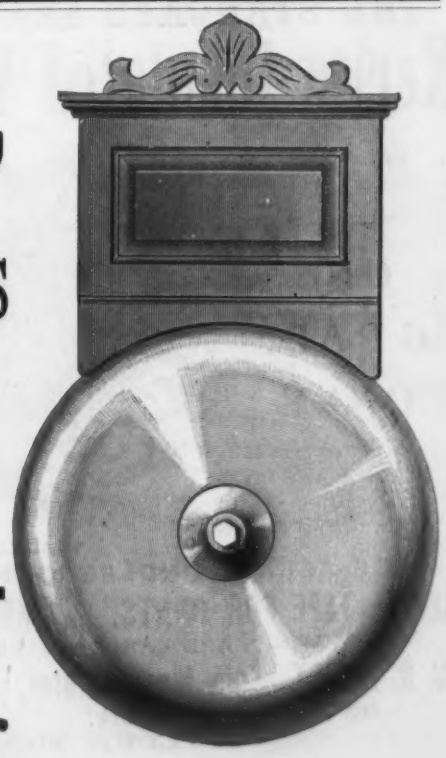

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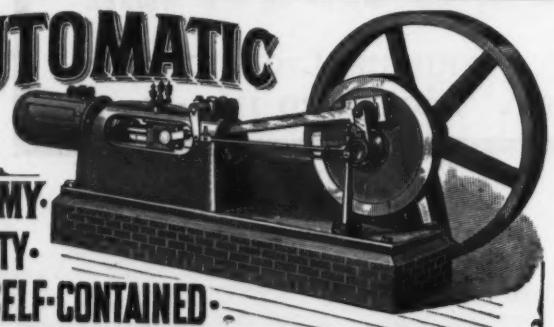

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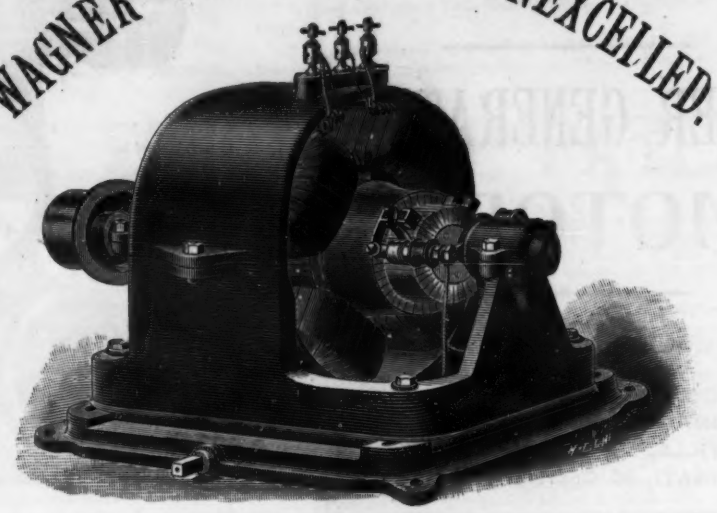

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